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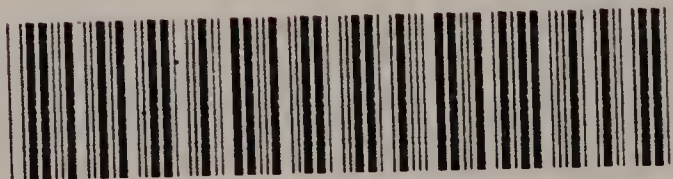
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THE
CHEMICAL NEWS

AND
JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

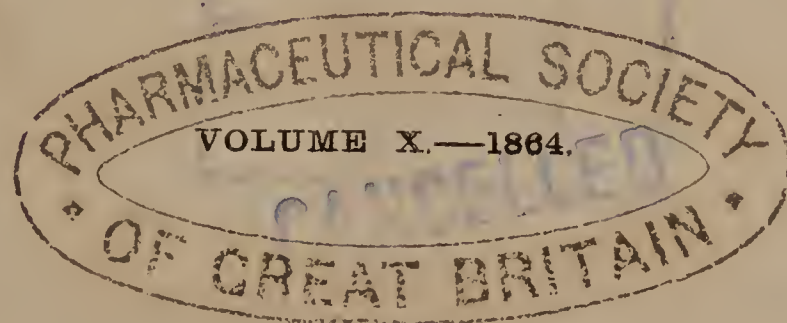
A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.



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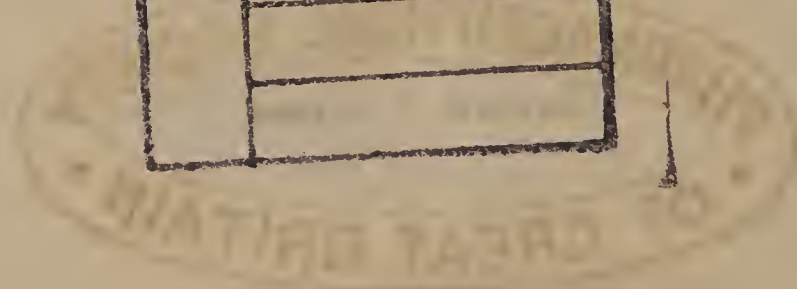
CHEMICAL NEWS

JOURNAL OF THE
+ ROYAL SOCIETY OF CHEMISTS

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Analysis of Mineral Phosphates, by R. WARINGTON, jun., F.C.S., Assistant to Professor CHURCH, Royal Agricultural College, Cirencester.

THE minerals which are at the present time chiefly resorted to as sources of phosphoric acid are apatite, guano, and coprolite. The analysis of some of these, as of the purer forms of apatite, and of Peruvian guano, presents but little difficulty, at least when the commercial value of the mineral is the object in view, but when we come to substances like coprolite, or the curious altered guano known as sombreroite, the case is different. These minerals generally contain a considerable amount of oxide of iron and alumina, besides lime, magnesia, &c., and we have to solve the serious problem of the estimation of phosphoric acid in the presence of these bases, as well as their separation from each other.

On consulting standard manuals of analysis, it is presently seen that very few of the processes there recommended for the determination of phosphoric acid are here applicable. The molybdic acid method is inadmissible from the large amount of phosphoric acid to be determined. The mercurial method fails us owing to the presence of alumina. The uranium method is equally unavailable from the presence of iron, or can be employed only if the iron be previously reduced by means of protochloride of uranium. The tin method is free from all these objections, and is no doubt, when carefully conducted, an excellent process, but the time it takes up is considerable, and it appears for other reasons to be unfitted for very general use.

Different methods have been employed by individual chemists, but none have proved so eminently satisfactory as to be extensively adopted. In this state of the case, the result of some experiments recently made in this laboratory may not be unacceptable to the agricultural analyst.

The subject divides itself into two parts, the estimation of phosphoric acid and of the alkaline earths, and the estimation of oxide of iron and alumina. In the first part of the subject we have to describe two methods, which were found to yield satisfactory results, the first has not, I think, previously been employed in the analysis of ferruginous phosphates.

The nitric acid solution* of the mineral, previously freed from silica in the usual way, is treated cautiously with dilute ammonia to remove all unnecessary excess of acid, the clear liquid is then treated in one of two ways; either an excess of neutral acetate of lead is added, or the solution is treated with nitrate of lead, and digested with successive portions of finely-powdered litharge till slightly alkaline, the liquid in this case being finally acidified with a few drops of acetic acid. The former plan is generally to be preferred, though the precipitate is considerably more bulky, as only a portion of the iron, and probably none of the alumina, is in this case precipitated with the phosphoric acid.

The precipitated phosphate of lead is warmed for some minutes to induce aggregation, and then thoroughly washed by decantation, the washings being filtered. The washing water should be slightly warm, and contain

a little acetate of ammonia, otherwise the filtrate is apt to be turbid.

There are several ways of treating the precipitate: it may be dissolved in nitric acid (which, for this purpose, must not be too weak), the solution diluted, and the lead precipitated by means of sulphuretted hydrogen; or the nitric solution may be treated with an excess of sulphuric acid, and the lead precipitated as sulphate. The first plan is unexceptionable, and yields excellent results; the necessary dilution entails, however, a subsequent concentration, which occupies some time. If acetate of lead has been used, perhaps the best plan for ordinary purposes is to treat the phosphate of lead with oxalic acid and a few drops of oxalate of potash. The decomposition is rapid and complete; the oxalate of lead may, after a short time, be separated by filtration. Oxalic acid does not perfectly decompose the highly aggregated precipitate obtained with nitrate of lead and litharge. The action of sulphuric acid on the precipitate is incomplete, whether nitrate or acetate of lead has been employed. Oxalate of lead is nearly insoluble in oxalic acid; its solution, if treated with sulphuretted hydrogen water, appears only very slightly discoloured when looking through a depth of several inches.

The lead being separated, the solution now contains the whole of the phosphoric acid, with a little iron; some citric acid is added, and an excess of ammonia; the clear solution is finally treated with magnesia mixture, and the phosphoric acid separated in the usual way.

The lime, magnesia, and alkalis are readily determined in the original filtrate from the phosphate of lead, the excess of lead being first precipitated by means of sulphuretted hydrogen. A little citric acid must be added before the solution is made ammoniacal for the determination of magnesia, to hold in solution the oxide of iron and alumina.

This method has the advantage of speed, and admits of the convenient determination of all the bases except iron and alumina; its accuracy has been carefully tried by operating on artificial mixtures of known composition. The results were very satisfactory.

The next method we have to describe is an old one. It is not adapted, like the preceding, to form part of a complete analysis, as the magnesia and alkalis cannot be conveniently determined; it will be found, however, when conducted as here described, a very good method for commercial purposes; it gives the best results when the amount of oxide of iron and alumina present is but small.

The acid solution of the mineral after separating silica, is cautiously treated with dilute ammonia till a slight permanent opalescence is produced; a drop or two of oxalic acid is then added, and the fluid allowed to stand; the opalescence will disappear, and the solution, if iron is present, will become yellow. An excess of oxalate of ammonia is now added, and the fluid warmed for some time to aggregate the oxalate of lime, which is then collected on a filter. The filtrate is concentrated, some citric acid added, and ammonia in excess, the phosphoric acid is then precipitated with magnesia mixture.

The oxalate of lime obtained will be found quite free from phosphoric acid; its amount, however, will be a little below the truth, from the partial solubility of oxalate of lime in oxalic acid. If to avoid this error, we attempt to neutralise the liquid before collecting the lime, phosphate of iron and alumina fall with the precipitate. The deficiency of lime amounted in the experiments to rather less than half a per cent.; the precipitate of phosphate of magnesia is not, however, in excess to

* When nitric acid alone is used to effect the solution of a coprolite a trace of phosphoric acid is sometimes left with the silica; it is therefore safest to dissolve in hydrochloric acid, and after the evaporation to dryness to redissolve with nitric acid.

that amount, as the citric acid not only holds in solution oxide of iron and alumina, but also, to some extent, oxalate of lime†. A trace of lime will, nevertheless, always be found in the magnesia precipitate, not, however, sufficient to vitiate the result for any ordinary purpose, if the operation has been properly conducted.

Citric acid should in every case be preferred to tartaric, on account of the superior solubility of its compounds with magnesia‡.

It has been suggested that oxalate of magnesia, being a sparingly soluble salt, is likely to fall with the phosphate, and also that fluoride of magnesium when present would be precipitated. These two sources of error appear, however, to be removed by the presence of citric acid. In experiments on the point no precipitate of these salts was obtained when citric acid was present, though occurring readily in its absence. The use of a great excess of magnesia is, however, always to be avoided.

We turn now to the second part of our subject, the determination of alumina and oxide of iron; this has to be effected in a separate analysis. One of the advantages promised by the tin method already referred to, is, that it admits of the determination of all the bases in one portion. We find, however, a hint in Fresenius that if much iron is present, a portion of this is held by the binoxide of tin. In experiments made with this method 3 per cent. only of oxide of iron was obtained from a coprolite known to contain 5 per cent.; the alumina was apparently unaffected. This is particularly unfortunate, as the separation of phosphoric acid by the tin leaves the bases all as nitrates, and consequently admitting of easy separation.

Alumina is best determined by precipitating the acid solution with excess of caustic soda, digesting for some time, and finally separating the clear fluid by decantation and filtration. The solution contains the alumina plus phosphoric acid. The phosphoric acid is easily removed by treating cautiously with chloride of barium till it ceases to produce a precipitate. A little carbonate of soda is then added to remove the excess of baryta; lastly, some more caustic soda. The whole is warmed and filtered. The alumina is separated from the filtrate in the usual way.

The original precipitate by soda contains the whole of the iron. This is best determined by the volumetric method with permanganate of potash. If, however, a gravimetric determination is desired, we proceed as follows:—The precipitate containing the mixed oxide of iron and phosphate of lime is dissolved in hydrochloric acid, a slight excess of ammonia added, and finally a considerable excess of acetic acid. The fluid is gently warmed for a few minutes. The precipitated phosphate of iron is then thoroughly washed by decantation. Thus obtained, the phosphate of iron always contains a portion of phosphate of lime. Nearly the whole of this may be got rid of by redissolving the precipitate and treating with ammonia and acetic acid as before. The precipitate may then be collected; its formula is $\text{Fe}_2\text{O}_3 \cdot \text{P}\text{O}_5$. The following is perhaps a more strictly accurate method of procedure. The washed phosphate of iron is dissolved in a small quantity of oxalic acid, a little oxalate of potash added, and the whole warmed. Any oxalate of lime formed is separated by filtration, and the filtrate boiled for some time with a considerable excess of caustic potash. The precipitate consists of pure oxide of iron, the potash having removed the whole of the

phosphoric acid.§ The oxide of iron is to be thoroughly washed by decantation, redissolved, precipitated by ammonia, collected, and weighed. The results are accurate.

Lime and magnesia may, if it is wished, be determined in the filtrate from the phosphate of iron.

The processes we have now mentioned have all been carefully tested, both qualitatively and quantitatively. Many of the reactions treated of are probably quite familiar to the readers of the CHEMICAL NEWS; the detailed description has, however, seemed necessary to give a complete view of the subject. In conclusion, I must express my obligations to Mr. C. Jacobsen, a graduate of the College, for his valuable assistance in these experiments.

Researches on Oxygen, by Dr. G. MEISSNER.

OUR attention has been called to a book with the above title;|| the contents are so important as to deserve more than an ordinary review. We propose, therefore, to give as concisely as possible an abstract of parts of the work, so that our readers may have clearly before them the views of the author, and the experiments by which they are supported.

We may pass over the introduction—in which the author gives a rapid sketch of the history of Schonbein's discoveries, and the researches of other chemists on ozone—and pass at once to the chapter on "Electrified Oxygen."

The apparatus used by Dr. Meissner was a modification of an instrument by Siemens, recommended by Von Babo. It is constructed as follows:—Twelve very fine copper wires, about five decimetres long, are each inserted into a very thin glass tube a little longer than the wire, and about 0.33 millimetres in diameter. Each of these tubes is sealed at one end, and at the other end is fused a thin platinum wire, which is twisted with the copper wire within the tube, and projects some centimetres outside the tube. The twelve tubes thus made are arranged within a larger glass tube seven millimetres wide and six decimetres long, so that the projecting platinum wires of six of them are at one end, and those of the other six are at the other end of the wide tube. These two sets of wires are each twisted about a larger platinum wire, which passes through and is fused into the wall of the wide tube. The tubes of the one bundle are distributed as equally as possible among those of the other, and placed in close contact, so that the spaces surrounding them may be as narrow as possible. [An excellent drawing of this apparatus accompanies the book.]

When the ends of these larger platinum wires are connected with the secondary coil of a powerful induction apparatus, the discharge takes through the walls of the smaller tubes, and through the air which surrounds them. The passage of the electricity takes place without sparks, and with very little noise. On approaching the ear only a faint crackling noise is heard. In the dark the bundle of small tubes is seen to be illuminated through its whole length with a reddish-violet light.

It is obvious that in the above-described apparatus platinum wires may be used through the whole system.

By the passage of the electricity the air surrounding the small tubes is strongly ozonised, and by means of a suitable arrangement this ozonised air may be removed for examination and fresh supplied. The author effected this by the pressure of a gasometer.

§ Northcote and Church. *Quart. Jour. Chem. Soc.*, vi., 53.

|| "Untersuchungen über den Sauerstoff;" von Dr. G. Meissner, Professor in Göttingen. Hanover. Hahn'sche, Hofbuchhandlung. 1863.

† Spiller. *Quart. Journ. Chem. Soc.*, x., 110.

‡ *Jour. Chem. Soc.*, I., 304.

In the course of the experiments it was found to be necessary that the air should be perfectly dried before it was electrified. Some difficulty was experienced in accomplishing this, but the author succeeded at last by using next the gasometer a wide tube over a metre long, filled with pieces of chloride of calcium, and then two or three tubes together at least one or one and a-half metres long, filled with coarse glass powder drenched with English sulphuric acid. The perfectly dried air, after passing through the ozoniser, was submitted to reagents in receivers of glass connected with the ozoniser by means of mercury joints, this metal being unaffected by dry ozone. [This part of the apparatus is also figured in the book.]

The first point the author set about investigating was whether, besides the formation of ozone, any other changes were produced in oxygen by the passage of electricity. He found that when the ozonised air was passed through a strong solution of iodide of potassium it was deprived of every trace of ozone; but when this deozonised air was passed through pure water, it reappeared as a thick white mist, sometimes so thick as to render the surface of the water quite opaque. The mist resembles that formed by the cooling of steam. Temperature seemed to have no perceptible effect on the mist, as it was formed equally when the air was at 35° and 0° C. It appeared also when the air passed merely through a moistened tube, and sometimes when it escaped from a weak solution of iodide of potassium. But when the solution of iodide was concentrated, and especially when the air was afterwards passed through a chloride of calcium tube, no mist appeared until the air again came in contact with water, showing that a certain amount of aqueous vapour is necessary to its formation.

The appearance of the mist ceases directly the induction apparatus ceases to work, and is denser or lighter according as the electrical action is vigorous or weak. It is seen just as well when pyrogallie acid or other deozonising agents are used in place of iodide of potassium, and moreover is formed when the dry electrified air comes at once in contact with water.

Pure oxygen, however procured, when electrified in the same way, gave the same appearance, while hydrogen and nitrogen suffered no change. The author was thus led to the conclusion that when oxygen is electrified another modification is produced simultaneously with ozone, which he naturally concluded was Schönbein's antozone. He failed at first to establish the identity, and therefore gave the name *atmizone* (ατμίζω—I smoke or fume) to this smoke-forming modification of oxygen. In the end, however, his researches left no doubt of the identity of atmizone with antozone.

(To be continued.)

Has Each of the Four Atoms of Hydrogen in CH₄, the Simplest Hydrocarbon, the same Function? by J. ALFRED WANKLYN.

A SIMILAR question has often been asked respecting ammonia, and the answer to the one will have an obvious bearing on the answer to the other.

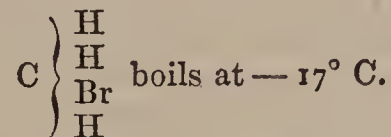
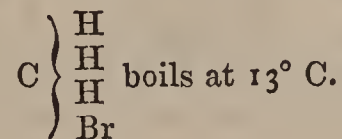
It will be admitted that the finding of different compounds in which an equivalent of the hydrogen is replaced by the same monatomic element will settle the point in the negative.

Such cases are easily found. Substitution by bromine furnishes one example.

Bromide of methyl boils at 13° C. It is obtained by

the action of bromine and phosphorus upon methylic alcohol. Any doubt that we might have about the real boiling point of the bromide of methyl will be removed by the consideration that the boiling point of bromide of ethyl is well known (40° C.), and that 13° C. is just about the calculated boiling point for the corresponding methyl compound.

A compound isomeric with bromide of methyl was obtained by Bunsen from the brom-hydrate of kakodylic acid. This compound is a gas. It condenses at about — 17° C.



Chlorine substitution also gives different compounds. Thus, chloride of methyl obtained by means of methylic alcohol, chloride of sodium, and sulphuric acid is different from the body obtained by acting upon marsh gas by means of chlorines.

Bayer has found the chloride of methyl prepared according to the former process dissolves in water at 14° C. to the extent of 4.172 times (i.e., one volume of water dissolves 4.172 volumes of the gas).

The compound prepared from marsh gas, on the other hand, is dissolved only to the extent of 0.08 at 14° C. Moreover, the former of these bodies forms a crystalline hydrate with water, the latter none. (See Bayer's paper.)

We are, therefore, forced to admit that the hydrogen in the most simple hydrocarbon has not all of it the same function; and since there is an isomer of the bromide and of the chloride of methyl, we should expect to find an isomer of methyl alcohol itself.

London Institution, June, 1864.

*On the Determination of Solubilities,**
by FRANK H. STORER.

THE term "solubility" is to be taken in its most comprehensive sense. I have no intention of attempting a strict definition of the word, or of discussing the forces upon which solution may depend. In the present state of science, the collection of experimental data, and the study and comparison of well-authenticated special observations, seem to be of far greater importance than the disputes of the earlier chemists whether the phenomena in question should be referred to the domain of chemical affinity, or be studied as a purely physical problem.† It need only be remarked that I am accustomed to class among phenomena of solubility all those reactions of liquids upon solid bodies, and those combinations of liquids with liquids—excluding, for the present, molten metals and other substances in a state of igneous fusion—in which the chemical force as understood by Berzelius, for instance, is not the principal, and, as it were, overwhelming force in action; we may have, perhaps, "solution" depending upon merely physical forces, like adhesion or cohesion, and also upon these forces *plus* a certain amount of chemical force. It can, indeed, hardly

* Extracted from the Preface to the "First Outlines of a Dictionary of the Solubilities of Chemical Substances."

† Dans les sciences naturelles, et surtout dans la chimie, les généralités doivent résulter de la connaissance minutieuse de chaque fait, et non la précéder.—Gay-Lussac, Premier Mémoire sur la Dissolubilité des Sels dans l'Eau.

admit of a doubt that the chemical force is exerted in many cases of solution, while, at the same time, other forces unquestionably come into play, in which connection the old adage that "like dissolves like" should be borne in mind. Hence, while the manifestations of chemical affinity proper, as evinced by the combination of bodies in simple and definite proportions, constitute the main subject of chemical text-books, many of the less clearly defined phenomena of chemical science may fairly come within the scope of a treatise on solubilities. Thus, though in the term "solubility of a substance" we ordinarily include only the comportment of the substance towards water, alcohol, wood spirit, ether, oil of turpentine, benzin, and analogous hydrocarbons, and the other "neutral solvents," it is obviously sometimes proper to add observations on the action of acids and alkalies; for example, any account of the solubility of nitrate of baryta would be manifestly incomplete without a statement of the fact that this salt is taken up but sparingly by nitric acid. Again, in the solution of chloride of silver in ammonia water, and that of various salts—as sulphate of lime, for example, in acids—there are probably at work other forces than the usual solvent power; but until the whole theory of solution is better understood we must be content to treat of these allied phenomena under the same general head of "solubilities."

Any extended discussion of the methods ordinarily employed in determining solubilities, and the precautions necessary to insure accuracy, would perhaps hardly be in place here. Directions for making such experiments may be found in several chemical handbooks—for example, in Fresenius's "System of Instruction in Quantitative Chemical Analysis," or, better, in the original memoirs of those chemists who have occupied themselves with the experimental determinations of solubilities, references to which may be found in the body of this work. It may, nevertheless, be well to remark here that the text-books do not usually lay sufficient stress upon the preparation of the solution of the substance under examination, and yet this is the single fundamental point of a correct determination, the other steps of the process being altogether subsidiary, and, in general, easy of execution, as well as comparatively free from sources of error. It is commonly stated that an exactly saturated solution of a salt may be prepared either by exposing a large excess of the salt to the action of the solvent during several hours at the desired temperature (method by digestion), or by heating a mixture of the salt and solvent until a strong solution has been obtained at a temperature higher than that at which the determination is to be made, and then cooling this solution to the desired degree, and maintaining it at this point for some time in contact with crystals of the salt, the whole being frequently agitated (method of cooling).

Now, the latter method, though theoretically correct, is, in practice, peculiarly liable to error, and great care should consequently be exercised in employing it. It is no doubt true that, as regards most substances, the saturated solutions prepared by either method would finally coincide in composition, provided the cooled solution be allowed to stand, under proper conditions, for a sufficient length of time. Yet it is often exceedingly difficult thus to obtain normally saturated solutions, even of our most common and easily crystallised salts, within the limits of time which can be conveniently allotted to a single experiment. This depends upon the tendency of the solutions of many, if not of most, substances to an indeterminate supersaturation when cooled from a higher to a lower temperature. This supersaturation is

not always easily to be detected unless comparative solutions are prepared by the method of digestion, and the length of time required by any given solution to assume the normal condition is a point not readily ascertained. Gay-Lussac, in his classical memoir upon the solubility of salts in water,† enjoins the necessity of maintaining the final temperature constant during at least two hours.§ His own experiments were made in the cellar of the Observatory at Paris, in which the thermometer varies but a fraction of a degree centigrade in the course of the year; they are unquestionably correct in themselves, and there can be little doubt that his statement regarding the preparation of normally-saturated solutions by the method of cooling is true, not only for the limited number of salts upon which he operated, but in general for crystalline substances. Yet the rule seems hardly safe to be followed in all cases by experimenters less favourably circumstanced, and it is obviously inapplicable to numerous uncrystallisable substances, or those liable to pass into an amorphous gum-like condition, or to undergo other molecular changes. The difficulty of avoiding supersaturation is, moreover, illustrated by the experience of Legrand, who found that solutions might become supersaturated to a certain extent even while they were actually boiling.||

Indeed, it is my opinion that, next to the impurity of the material operated upon, by which many published determinations have unquestionably been vitiated, there is no source of error so grave, none which has so seldom been fully guarded against, or so often altogether overlooked, as this tendency to supersaturation.

On the other hand, in the preparation of solutions by the method of digestion a difficulty is encountered in the tendency of many substances—like arsenious acid, for example—to dissolve with extreme slowness. This can, however, be overcome by the exercise of patience, and, in any event, admits of being detected and controlled. It would, therefore, appear that, where practicable, the method by digestion should generally be preferred, at least for temperatures low enough to insure the experiments against the influence of evaporation. The completion of the solution can then always be ascertained by determining from time to time the amount of substance dissolved, the operation being considered finished when the results of two of these tests accord with each other. As frequent agitation is indispensable, some process of stirring by machinery moved by clock-work, analogous to that described in Mohr's *Lehrbuch der Pharmaceutischen Technik*, might probably here be used with advantage.¶ Kemp's regulator** for maintaining constant temperatures might also be found serviceable in some cases.

† *Annales de Chimie et de Physique*, 1819 (2), 11, 298.

§ "Dans chaque cas il faut maintenir constante la température finale pendant deux heures au moins, et remuer fréquemment la dissolution saline, pour être bien assuré de sa parfaite saturation."

|| "Il semble d'abord que pour avoir cette température, il n'y a que observer celle à laquelle le sel commence à se déposer; mais on n'aurait ainsi rien de constant, il faut prendre celle qui a lieu pendant que le sel se dépose. En effet, j'ai remarqué que la dissolution pouvait se saturer malgré le mouvement d'ébullition, et attendre une température de plus en plus élevée; mais aussitôt que le sel se dépose, le thermomètre redescend en un point où il se tient parfaitement fixe."—*Ann. Ch. et Phys.* (2), 59, 428.

¶ Compare Berzelius in his *Lehrbuch*, 3, 32, et seq.

** Liebig and Kopp's *Jahresbericht*, 3620, 10,612, 12,709; also *Journal of the Franklin Institute*, (3), 25, 319.

Royal Institution.—The general monthly meeting will be held on Monday, July 4, at two o'clock.

PHYSICAL SCIENCE.

Suggestions for a Thermo-Spectrometer, by WILLIAM CROOKES, F.R.S.

WHEN soda is brought into a flame and the emergent light examined in the spectroscope it is seen to be of one degree of refrangibility only. Over the whole range of the visible spectrum, from the lowest red to the extreme violet, only one narrow line vibrates in synchrony with the heated soda atoms. But Professor Magnus has lately shown that *heat* is likewise given off by the soda flame in very large quantities, and these heat rays are just as much a portion of the spectrum as the visible or the actinic rays. If, therefore, we had some means of observing the thermic spectrum we should find that the sodium spectrum was far from simple. Optically, sodium stands next to thallium in the simplicity of its spectrum; at ordinary flame temperatures, thallium radiates one, whilst sodium radiates two homogeneous rays; these latter so close together, as to appear but one in ordinary instruments. Other metals give more complicated visible spectra; the activity imparted to them by the high temperature is expended over a wide extent of the coloured spectrum, whilst with sodium and thallium, the energy is concentrated into one line; hence the wonderful luminosity of these homogeneous lights, and the excessive brilliancy which they exhibit in comparison with other coloured flames given by different metals. Sodium, however, spends some of its vibrative energy in the invisible heat spectrum, and it would be a matter of considerable interest to examine whether the other metals, such as lithium and thallium, which give simple optical spectra, also radiate heat rays. This has indeed been found to be the case with lithium, which is stated by Professor Magnus to act like sodium, and it is probable that thallium would act in a similar manner; but from these theoretical considerations we should not expect to find that metals which yielded complicated optical spectra, such as barium or copper, would also emit heat rays of great intensity. Physicists now require a thermo-spectroscope, or, rather, spectrometer—an instrument which will enable them to examine and map out the thermal lines of the spectrum, as accurately as this can be done with the visible and photographic portion. With light (or rather with heat radiations) of tolerable intensity, this would not be difficult to effect. A single row of antimony and tellurium bars, soldered together at their alternate ends, as in the ordinary antimony-bismuth thermo-electric pile, could be securely cemented to a solid plate of glass and ground perfectly flat. This flat side could then be cemented to a permanent support of glass, porcelain, ebonite, or other suitable non-conducting material, and the other side (after removal of the temporary glass support) should be likewise ground down, until the series of bars was no thicker than a card. This side should now be cemented on to the same kind of supporting material as was used for the other side, and the whole firmly and securely sealed up at the sides, so as to leave only the ends exposed. The end of this pile would now be in the form of a very narrow line, which might be half an inch or so in length, and would consist of the extremities of ten or a dozen couples of antimony and tellurium bars, each not larger than a pin. The extremities of this battery being connected with a very sensitive galvanometer; the pile, upon being carried along the ultra-red end of the spectrum, would instantly reveal when a ray of heat shone upon it, by a deflection of the needle; and the comparative intensities of the

thermic rays could be, at the same time, ascertained from the angular distance to which the needle was driven. In this manner heat spectra could be mapped out with considerable accuracy.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 16, 1864.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,
in the Chair.

THE minutes of the preceding meeting having been read and confirmed and the several donations to the Society's library announced, Charles Tomlinson, Esq., Lecturer on Science in King's College, London, was formally admitted a Fellow of the Society, and the undermentioned gentlemen were duly elected by ballot—viz., G. W. Knox, B. Sc., Bristol; Michael Carpaël, New Bond Street; Sidney Pontifex, Leadenhall Street.

A paper, by C. SCHORLEMMER, Esq., "*On the Identity of Methyl and Hydride of Ethyl*," was read by the Secretary. The author commenced by referring to an experiment in which equal volumes of chlorine and the gaseous hydride of ethyl were exposed to diffused daylight, and the chlorine substitution products thus obtained were collected and purified in the manner fully described in a communication to the Royal Society, entitled "*On the Action of Chlorine upon Methyl*." A colourless mobile liquid, condensed in the receiver, which consisted chiefly of chloride of ethyl, C_2H_5Cl , boiling at $11^\circ C$. Besides this compound, a small quantity of a liquid having a higher boiling-point was formed, from which monochlorinated chloride of ethyl, $C_2H_4Cl_2$, could be isolated. The results of these experiments differed widely from those of older researches of Frankland and Kolbe, who studied the action of chlorine upon the gas obtained by treating cyanide of ethyl with potassium, which they first considered as methyl, but afterwards recognised as hydride of ethyl. By the action of one volume of chlorine upon one volume of hydride of ethyl, they obtained one volume of hydrochloric acid and one volume of a gas having the composition C_2H_5Cl , which substance was believed not to be chloride of ethyl because it could not be condensed at $-18^\circ C$. Frankland showed afterwards that by the action of two volumes of chlorine upon one volume of hydride of ethyl, a liquid substitution product was formed, but that by acting with one or two volumes of chlorine upon one volume of methyl only, gaseous chlorine compounds were formed. Frankland and Kolbe performed their experiments with perfectly dry gases, whereas the author employed them in the moist state. It therefore became necessary to repeat the experiments of Frankland and Kolbe exactly under the circumstances described by them, only on a larger scale; but the author obtained results coinciding with those already described as having been furnished by the moist gases. One volume of chlorine and one of methyl, or one volume of hydride of ethyl, in the dry or moist state, yielded one volume of hydrochloric acid and chloride of ethyl, which always contained a small quantity of its chlorine substitution products. From these experiments it would appear that there does not exist any chemical difference between methyl and hydride of ethyl, and that the lowest isomeric terms of the two series of radicals and hydride stand in the same relation as the higher terms do. With regard to differences in their physical properties, the author considered that, like all isomeric hydrocarbons of these groups, they exhibit a close agreement, and only in their degrees of solubility in water was a slight disagreement noticed. The values of the coefficients of absorption of methyl are a little smaller than those of hydride of ethyl, but the curves representing these coefficients are

nearly parallel, and very close to each other. Schickendanz, who determined the solubility of hydride of ethyl in water, thinks that it would appear probable that this relation between the coefficients of absorption of the two gases was not accidental, but might be attributable to their chemical constitution as isomeric bodies. The author believes that the slight difference in the solubility and the parallelism of the two curves may easily be accounted for by the existence of impurities in the methyl employed by Bunsen, which was prepared by the action of zinc upon iodide of methyl, a method which yields the least pure product, and even a small admixture of a foreign gas cannot fail to exercise a considerable influence on the value of the coefficients. In alcohol the two gases are also soluble in the same proportions, and hence the author believes himself justified in asserting "that until differences are found between methyl and hydride of ethyl better marked than those above mentioned, we must consider the hydrocarbons, C_2H_6 , derived from different sources, as identical, and as being hydride of ethyl or deutyl."

The PRESIDENT considered the author's communication to have an important bearing upon the theory of radicals. The results so far were mainly of a negative character. One proof of identity had been brought forward; but otherwise there did not appear to be any difference between the chemical properties of methyl and those of the hydride of ethyl.

Dr. FRANKLAND did not allow the author's experiments to be conclusive, especially those relating to the production of the normal chloride of ethyl in the presence of water. Dr. Kolbe and himself had investigated the action of potassium upon the cyanide of ethyl, and the results were exactly in accordance with the published statements just now called in question by Mr. Schorlemmer. Further researches were required before the identity or isomerism of these bodies could be determined. For himself, he believed they were not identical, but only isomeric.

Mr. C. H. GREVILLE WILLIAMS said that this class of investigations was attended with the greatest possible difficulty; and it behoved us to suspend our judgments. Amongst the products of the destructive distillation of Boghead coal were several substances having the same composition and boiling point (excepting butyl), and giving similar nitro-compounds with fuming nitric acid. Recent investigations of the tertiary monamines of the picoline series had led him to the conclusion that the lutidine derived from the destructive distillation of quinine is not the same as the lutidine of Boghead naphtha.

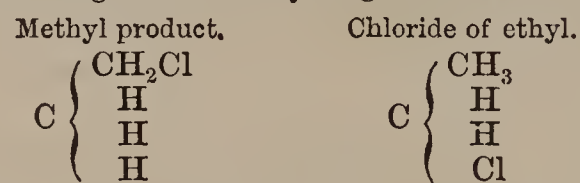
Professor WANKLYN would have been glad to know whether the chlorine substitution product obtained by Mr. Schorlemmer was the veritable chloride of ethyl. It might have been but an isomer. Ethyl boils at $20^\circ C.$, whilst hydride of butyl, which is absolutely identical with it in composition, boils at about zero; thus showing a considerable difference of 20° . In a similar manner the hydride of hexyl obtained from mannite is only isomeric, but not identical, with that prepared from Boghead coal. An interesting fact had recently been made known by Carius, to which reference should have been made in the author's paper—viz., that, by acting upon ethyl with bromine, the bibromide of butylene was produced. Again, to Cahours and Pelouse was due the generality of the method of investigation followed by Mr. Schorlemmer; and he considered that this circumstance should have been acknowledged by the author.

Dr. ODLING thought great praise was due to Mr. Schorlemmer for having upset the only point which has hitherto been relied upon as establishing a difference between methyl and the hydride of ethyl. The difference in their coefficients of absorption was really so slight as to be easily accounted for by variations in the degree of purity of the substances. The author had a full right to adopt an opinion contrary to that of Dr. Frankland, and to consider

these bodies identical, not merely isomeric. With reference to Professor Wanklyn's remark, he felt it impossible to acknowledge continually the prior labours or steps in an investigation already ascertained by other experimentalists. It was not necessary at the present time, and positively inconvenient, to have always to mention Bechamp's name in connexion with the admirable process of reduction with acetic acid and iron filings, which chemists had already given him the credit of having originated.

Sir BENJAMIN BRODIE having inquired whether any difference in constitution was supposed to exist, which would account for the discrepancies regarding the chlorine substitution products?

Dr. FRANKLAND wrote upon the board the formulæ under-mentioned, and he believed it possible that in one example the chlorine replaced an atom of hydrogen forming part of the radical, and in the other instance attacked only one of the outstanding atoms of hydrogen, thus:—



Professor WANKLYN suggested there might then be twenty-four possible combinations.

The PRESIDENT then called upon the Secretary to read a paper "*On the Action of Baryta on Suberic Acid*," by Mr. Richard Dale, of Owen's College, Manchester. The author commenced by referring to the hydrocarbons C_6H_{14} and C_8H_{18} , boiling at 76° and $125^\circ C$ respectively, and stated that his experiments had for their object the isolation of an intermediate number of this group. By the action of nitric acid on castor oil, suberic acid $C_8H_{14}O_4$, and azelaic acid, $C_9H_{16}O_4$, were conjointly produced. The white powder resulting from this action was treated with ether, in which the latter was more soluble. The suberic acid was obtained in needle-shaped crystals, and the azelaic acid in pearly white scales. From two and a-half kilogrammes of castor oil 90 grammes of suberic acid and 75 of azelaic acid were obtained. The acids and silver salts were analysed, and when azelaic acid was distilled with baryta, the hydride of heptyl, boiling at $99^\circ C.$, (Schorlemmer) was obtained.

The remainder of the evening was devoted to the description of "*Vacuum Experiments*," by Dr. Hermann Sprengel, which will be given in our next. The meeting was then adjourned until the 30th June.

LECTURES ON CHEMICAL PHILOSOPHY.

Delivered at the College of France, by M. A. WURTZ.

[THE course of lectures recently delivered by M. Wurtz has been devoted to the exposition of modern theories in chemistry, and we have thought that their reproduction here in abstract would be of interest to our readers who seek for a lucid explanation of recent ideas.]

In the present course of lectures I propose to expound the chemical theories which have of late years directed the investigations of many experimenters, and which are now beginning to prevail. I shall endeavour to do this with the modesty belonging to a *savant*, and with the respect which is due to the opinions of others. I know that our theories are subject to variation, growing with the progress of knowledge, and sometimes only the expression of a momentary want. But I know, also, that theory is the soul of science, the torch of experiment, and that from it has proceeded what we call the new chemistry.

Strictly speaking, there is no new chemistry. In the development of chemical ideas there have been no sudden changes, no violent subversions, in a word, no revolutions. Chemistry, since Lavoisier, has been in a state of continued

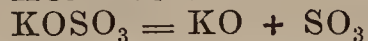
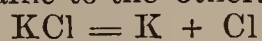
steady progress. But things have not essentially changed; the chemistry of to-day is only a continuation of the chemistry of the beginning of the century. All the modifications accomplished since Lavoisier have been produced by rational experiment, the influence of which is necessarily permanent. To enlighten ourselves on this point let us endeavour to follow the progress of the theory of the science from Lavoisier's time to our own.

Positive chemistry arose from an attentive study of the phenomena of combustion and the constitution of salts. It was observed that the calcination of a metal was nothing less than the combination of the metal with oxygen, the formation of an oxide, in fact. It was seen, also, that acids result in general from the addition of oxygen to another substance. At last it was proved that salts were easily formed by the union of an acid and an oxide. Other observations confirmatory of the preceding were made, and in time it was said that all salts were binary—that is to say, compounds of an acid and a base; or to express it more generally—that every compound system could be divided into two more simple antagonistic systems. That was the foundation of the edifice raised by Lavoisier. That was the base of *dualism*.

The labours of those who immediately followed the founders of chemical science, the discoveries of the composition of the alkalis and the elementary nature of chlorine; the discovery, also, of the composition of cyanogen, which, notwithstanding its complex nature, formed binary compounds exactly like the binary compounds of chlorine, &c.—all these facts appeared a striking confirmation of the ideas of Lavoisier.

Berzelius, by discovering the double chlorides and double sulphides, which he named chloro-salts and sulpho-salts, contributed to strengthen these ideas. He did more than this; he attempted a theoretical explanation of dualism, and published an hypothesis which has had a great success—the electro-chemical theory.

We know that bodies combine in definite proportions, and sometimes in multiples of those proportions. We know, also, that Dalton, to explain this general law, supposed the existence in every simple body of small indivisible masses or atoms, each having a particular weight—the atomic weight; and that compound bodies are formed of these atoms placed in juxtaposition. Berzelius seized on the idea of the atoms, and supposed each to have two poles in an opposite electrical state. In some atoms positive electricity predominates, in others it is the negative. Bring two atoms in opposite electrical states together, and they attract each other and unite. Suppose three or four of them, they will always constitute two antagonistic groups, so that the resulting compounds will be constantly binary. Such was the theory of Berzelius. The only proof of the truth of this theory Berzelius required was the action of a current upon chemical compounds. Chloride of potassium, for example, decomposed by the current into two simple bodies, chlorine and potassium; sulphate of potash is also decomposed into potash and sulphuric acid, the metallic group going to one pole and the non-metallic to the other.



Here, then, was the verification of the hypothesis! No: for, as we shall show further, the experiments on which the illustrious Swedish chemist relied must be turned against him. The interpretation which he gave of them was not exact.

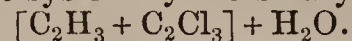
Dualism, however, being in the estimation of Berzelius the general expression of truth, he set about applying it to the whole science. Lavoisier had already spoken of *compound radicals* which could unite with oxygen to form acids; that is to say, he had considered these acids as *couples*. Berzelius went a step further, and believed that it must be so with all bodies. Thus, according to him, acetic anhydride, $\text{C}_4\text{H}_6\text{O}_3$, is formed of the radical acetylene,

C_4H_6 and O_3 . Ordinary acetic acid he supposes a compound of acetic anhydride, $\text{C}_4\text{H}_6\text{O}_3$, and water, H_2O ; that is, an hydrate, a salt, composed of acid and base. Sulphuric anhydride again, SO_3 , combines with water, H_2O , to form sulphuric acid, $\text{SO}_3\text{H}_2\text{O}$,—a binary compound, an hydrate, in fact.

Endowed with a grand imagination, Berzelius succeeded in bringing all the great discoveries in chemistry up to 1830 into agreement with his ideas. Thus when Chevreul published his remarkable investigations on fatty bodies, and showed that fats are neutral bodies composed of glycerine and a fatty acid, Berzelius contended that glycerine was an oxide of lipyl. In the same way he explained the discoveries of Dumas and Boullay on the compound ethers. These, said he, are compounds of an acid with oxide of ethyl, $\text{C}_4\text{H}_{10}\text{O}$. Acetic ether, for example, contains $\text{C}_4\text{H}_6\text{O}_3 + \text{C}_4\text{H}_{10}\text{O}$, just as sulphate of potash is $\text{SO}_3 + \text{KO}$. The remarkable results obtained by Liebig and Wöhler with the benzoic compounds were explained in a similar way. Thus, we see that up to 1830 chemists in general sought to apply to organic bodies the current ideas on mineral chemistry.

But now from 1834 a change begins. A great discovery has been made. Dumas and Laurent have found that chlorine, an electro-negative body, may be substituted for hydrogen, an electro-positive body; that is to say, chlorine may be combined otherwise than by molecular addition—in other words, by substitution. Chlorine may be substituted for hydrogen, equivalent for equivalent. This was afterwards confirmed, and the researches were extended by Laurent, Gerhardt, Malaguti; but the first announcement by Dumas of the discovery and its consequences was sufficiently precise to disconcert any other chemist but Berzelius. He not only refused to modify his theory, he even pretended that dualism was not affected, and laughed at the theory of substitutions.

Let us see how he disposed the notation of some organic compounds. Formic acid, for example, $\text{C}_2\text{H}_4\text{O}_4$, is formed of a radical, $\text{C}_2\text{H}_2\text{O}$, and water, H_2O ; it is a binary compound, a couple. Chloroform, which, according to Dumas, is only the result of the substitution of 3 Cl for 3 H in C_2H_4 , and which may therefore be represented as $\text{C}_2(\text{HCl}_3)$, chloroform is according to the dualist a compound of the radical C_2H_2 and 3 Cl. Trichloroacetic acid is also represented in the system by the binary symbol



Such is the dualistic system of Berzelius, and every one will admit that supposing the experimental starting point to be correct, such deductions must always have been rash and hypothetical. But, as we shall proceed to show, the starting point was not correct.

There was, then, an urgent need of a chemical theory at once more comprehensive, more positive, and more rational than that of Berzelius. We shall see it born, and slowly develop itself.

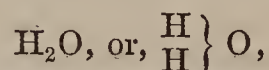
Dumas, taking experiment and rigorous induction as his sole supports, was led to represent acetic acid as $\text{C}_4\text{H}_8\text{O}_4$, and trichloroacetic acid as $\text{C}_4(\text{H}_2\text{Cl}_6)\text{O}_4$. Having observed, in fact, that the chemical properties of the chlorinated acid are completely analogous to those of the ordinary acid, and that the quantity of hydrogen which disappeared was exactly equivalent to the quantity of chlorine substituted, he naturally concluded that if $\text{C}_4\text{H}_8\text{O}_4$ is the experimental expression, so to speak, of the normal acid, $\text{C}_4(\text{H}_2\text{Cl}_6)\text{O}_4$ is that of the chlorinated acid. In other words, said he, trichloroacetic acid *belongs to the same type* as acetic acid. This was the origin of the theory of types.

Dumas at first believed in two kinds of types; the *chemical* type of which he was himself the author; and the *mechanical* type, the first idea of which was started by Regnault. Compounds belonging to the chemical type are those which contain the same number of atoms similarly united, and whose fundamental chemical pro-

perties are identical. Compounds belonging to the mechanical type are those which while containing the same number of atoms present dissimilarities in the chemical characters of their products of metamorphosis. We mention the latter only for the sake of historical accuracy. In what follows we shall speak only of chemical types.

At first the theory of types was only applied to the hydrogenated compounds of carbon, and their oxygen, chlorine, and bromine, &c., derivatives by substitution. There was a great number of types, and they only included a small number of compounds. But thanks to the researches of Laurent, Williamson, and especially of Gerhardt, the theory of types was at once simplified, and, moreover, received an indefinite extension. It was Laurent who first showed that oxides are exactly analogous to hydrates; that the one and the other only differ from water by the substitution of one or two atoms of metal for one or two atoms of hydrogen; that, for example, if we represent water as H_2O , caustic potash is $(KH)O$, and oxide of silver Ag_2O . Thus he inferred that water is the type of oxides.

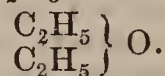
Then came the experiments of Williamson on etherification, which showed that hydrate of ethyle was nothing more than water,



in which one atom of hydrogen H is replaced by the group C_2H_5



and that ether is water in which both atoms of H is replaced by the group C_2H_5

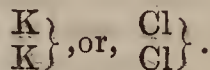


Gerhardt seized on these results and on others at which he had arrived in the study of the ammonia compounds and the anhydrides, brought together and compared all these ideas and facts, and by his powerful mind for generalisation produced a theory of types entirely novel. His theory consisted in the choice of four simple types—hydrogen, water, hydrochloric acid, and ammonia—in relation to which we may place, or from which we may derive, by substitution, all the other compounds of mineral and organic chemistry.

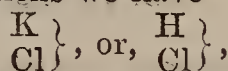
We have already shown how the water type and its derivatives are expressed. Let us now consider the hydrogen type. Hydrogen is figured as



The bodies belonging to the same type, if simple, are similarly expressed

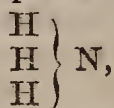


If we effect substitutions we have



bodies belonging to the same type.

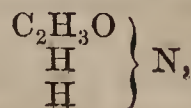
The ammonia type is represented as



a formula in which we may substitute for a variable quantity of H , a variable quantity of any other simple radical or group. Thus, by substituting one of K for one of H we have



or potassium amide, and if we replace one of H by C_2H_3O , we shall have



or acetamide.

This is the foundation of the theory of types of which Gerhardt is the author. It bears the stamp of his genius, and is at once simple and fruitful. Since his time, and by the hands of other chemists, discoveries have succeeded discoveries with a rapidity until now unknown in the history of sciences; organic chemistry has received an unimagined extension, and that gift of foreseeing which is the characteristic of rational progress has been greatly developed.

(To be continued.)

ACADEMY OF SCIENCES.

June 20.

THE proceedings of the last meeting of the Academy offer but little of interest to chemists.

Dr. Hofmann contributed a paper, entitled "*Facts Relating to the History of the Colouring Matters Derived from Coal-Tar.*" In this paper he describes an oil obtained by the dry distillation of aniline blue. The author is disposed to regard the product as diphenylamine. With nitric acid, and apparently all oxidising agents, diphenylamine yields a magnificent blue colour. Some other reactions of this body are curious, and we shall return to them.

A fact of great importance was mentioned in a memoir by M. Langier. The author sewed together the divided ends of a median nerve, and found that they perfectly united. Sensation and power of motion were re-established in the limb in the course of some days, and to a certain extent in a few hours.

NOTICES OF BOOKS.

A Companion to the British Pharmacopœia; comparing the Strength of the Various Preparations with those of the London, Edinburgh, and Dublin, United States, and other Foreign Pharmacopœias; with Practical Hints on Prescribing. By PETER SQUIRE, F.L.S., &c., &c. London: Churchill and Sons. 1864.

MR. SQUIRE is already favourably known to the Medical and Pharmaceutical world as the author of two very useful compilations. The present work will greatly increase his reputation. *Par excellence* it is the work on the British Pharmacopœia.

We shall give our readers the best idea of the contents and method of the book by making a short extract:—

"DIGITALIS.

"The dried leaf of the *Digitalis purpurea*, gathered when about two-thirds of the flowers are expanded.

"Medicinal Properties.

"Sedative and diuretic. Much used in various cardiac affections. It is cumulative in action, and requires much caution. Externally a strong infusion may be applied for dropsy.

"Preparations.

"INFUSUM.—Digitalis, dried, 30 grains; boiling distilled water, 10 grains; infuse one hour and strain.

"(Same strength as Lond.; half that of Edin. and Dub.) Dose, $\frac{1}{2}$ to 1 oz.

"TINCTURA.—Digitalis, dried and bruised, 1; proof spirit, 8; macerate forty-eight hours with 6 of spirit, agitating occasionally; pack in a percolater and let it drain, then pour on the remaining spirit; when it ceases to drop, press and wash the marc to make up 8.

"(Same as Dub.; Lond. and Edin., 1 to 10; Fr. 1 to 5; Belg., 1 to 6; Pr., 1 to 7; Austr., 1 to 8.)

"Dose—as a diuretic, 20 to 30 minims."

The above extract requires a little explanation. It will be seen that Mr. Squire expresses some of the formulæ in parts. So long as these are taken as ounces no doubt will be felt, since the author gives at the top of each page the general direction "solids by weight, liquids by mea-

sure." But if pounds are thought of, it must be remembered that by a liquid pound the author means sixteen fluid ounces.

Aiming also at great conciseness, the author will at times puzzle a simple-minded reader, as at page 14, where he describes Etheris nitrosi spiritus as "distilled from nitrite of soda." It would have been better in such a case to have given the whole directions. There is, however, a note to this preparation which we give as a sample of the remarks which will be found scattered about the book.

"This preparation will always be of uncertain strength, in consequence of the variable composition of the nitrite of soda made according to the Pharmacopœia. This substance is a mixture of nitrate, nitrite, carbonate, and caustic soda, and will in no case fulfil the conditions laid down in the Pharmacopœia test. The proportion of nitrite will vary from 5 to 25 per cent. (never more), and the strength of the spirit of nitrous ether will be influenced accordingly."

There are also some remarks on the Liquor ferri perchloridi which we are tempted to extract:—

"Liquor ferri perchloridi made by the process of the Pharmacopœia has a sp. gr. 1.395, is almost black, and contains both protochloride of iron and free nitric acid. When mixed with three times its volume of rectified spirit, as directed for making the tincture, a considerable deposit is soon produced. If the evaporation is pushed to 6 ounces instead of 10 as directed, complete oxidation takes place, but a large quantity of basic chloride is thrown down, because there is not sufficient hydrochloric acid to keep it in solution, and the nitric acid is not got rid of. This, by gradually acting upon the alcohol, producing ether, will cause the tincture to become turbid.

"In order to have a successful result, the quantity of hydrochloric acid must be augmented to 13 ounces, and the solution should be evaporated to 5 ounces. The addition of 5 ounces of water will then bring up the bulk to 10 ounces, as required by the Pharmacopœia, and the sp. gr. will be 1.400. The tincture made with this solution will remain bright, and have the sp. gr. 0.992."

Mr. Squire was a member of the Pharmacopœia Committee, and we must express our regret that he has had to make such remarks as the foregoing in his book.

There is one useful feature in the work to which we shall call attention by another extract. The author, as often as necessary, after the officinal preparations of a medicine, gives a list of non-officinal remedies. Here is one:—"Tinctura chloroformi composita.—Chloroform, 4 oz.; rectified spirit, 4 oz.; treacle, 4 oz.; extract of liquorice, 2½ oz.; muriate of morphia, 8 grains; oil of peppermint, 16 minims; syrup, 17½ oz.; prussic acid (2 per cent.), 2 oz."

This, the author states, has been represented to him as the composition of chlorodyne, but we cannot suppose he believes the representation correct. There will be less than a quarter of a grain of muriate of morphia in an ounce of the above preparation, and Mr. Squire gives the maximum dose at 10 minims.

We have no wish, however, to be hypercritical on a work which contains so much to be commended; and shall now only repeat our already expressed opinion that this is the best work which has yet appeared on the British Pharmacopœia.

Annales de Chimie et de Physique. May, 1864.

THE greater part of this journal is filled with a paper by M. Baudrimont "On the Chlorides and Bromides of Phosphorus." The novelties in the paper are thus summed up:

1. Phosphoric chloride (PCl_5) attacks most elements, and especially the metals, sometimes forming double chlorides, more often forming a metallic chloride and phosphorous chloride (PCl_3).

2. Phosphoric chloride also attacks sulphides, and forms metallic sulpho-phosphides.

3. Sulphophosphide of mercury has a definite composition:— $\text{PS}_3, 3(\text{HgS})$.

4. Chlorosulphide of phosphorus can be obtained by the action of PCl_5 on SbS_3 .

5. Many chlorides may combine with PCl_5 to form well-defined compounds.

6. Among these is a compound of bichloride of platinum with PCl_5 obtained by sublimation.

7. Phosphoric bromide, PBr_5 , dissociates easily. In the presence of carbonic acid it splits up completely into PBr_3 and free bromine.

8 and 9. A bromoxide of phosphorus, PBr_3O_2 , and a bromosulphide of phosphorus, PBr_3S_2 , exist.

The author concludes his paper with a caution to experimenters on the disastrous effects of breathing the vapours of the chlorides of phosphorus and their derivatives.

An interesting memoir by M. Barbier follows, "On the Application of the Phenomena of Capillarity to the Construction of Various Thermometers," which is much too long for us to transcribe, and which would hardly be intelligible without the accompanying plates.

A translation of Mr. Graham's paper "On the Molecular Mobility of Gases" concludes the number, showing that its importance and value are thoroughly appreciated by our neighbours. It is the third translation into French we have noticed.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1320. James Haswell Burke, London, "Improvements in lamps, vessels, tubes, and cocks, especially useful for preventing the transmission of flame or explosive action when using petroleum, camphine, or other inflammable or explosive substances."—Petition recorded May 27, 1864.

1335. Thomas Drew, the elder, Derby Villa, Tranmere Park, Birkenhead, "Improvements in the manufacture of paper, papier mache, and millboard."

1342. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the treatment of the low or poor products obtained in the manufacture or refining of sugar."—A communication from Eugene Bartholomey, Rue St. Sebastien, Paris, France.—Petitions recorded May 30, 1864.

1346. George Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in artificial teeth, and in moulds for forming the same."—A communication from John Terrel and Joseph Stulb, Philadelphia, Pennsylvania, U.S.—Petition recorded May 31, 1864.

1286.—Richard Archibald Brooman, Fleet Street, London, "Improvements in apparatus for increasing the illuminating power of gas, and for producing gas by the vaporisation of hydrocarbons and essences of petroleum."—A communication from Gustave Bouchery and Jules François le Batteux, Paris, France.—Petition recorded May 21, 1864.

1336.—James Paterson, Greenock, N.B., "Certain improvements in the cooling and preparation of charcoal to be used for refining sugar, and in the machinery, apparatus, or means employed therefor."—Petition recorded May 30, 1864.

1366.—Oscar Eugen Prieger, Bonn, Prussia, "The manufacture of ferromanganese and cupromanganese, and the combinations or alloys thereof with other metals."

1368.—William Cormack, Little Moorfields, London, "Improvements in the distillation or destructive distillation of all solid matters or semi-solid matters capable of yielding fluids, or gaseous hydrocarbons, or other products of any kind whatsoever, be they liquids, fluids, or solids, such as pit-coal, boghead, or other bituminous coal or shale, peat, wood, asphalt, tallow, lard, fats, or other semi-solid matters, and in the treatment of the same."

1370.—William Henry Mellor, Liverpool, Lancashire, "Improvements in self-acting, mashing, or saturating apparatus for the use of brewers, distillers, and others."—Petitions recorded June 2, 1864.

1386.—William Clark, Chancery Lane, Middlesex, "Improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive driving power."—A communication from Jean Henry Cazal, Boulevard St. Martin, Paris.

1387.—Bondy Azulay, Rotherhithe, Surrey, "Improvements in treating petroleum and its products, and in the application of apparatus for that purpose."—Petitions recorded June 3, 1864.

1401.—James Napier, Glasgow, Lanarkshire, "Improvements in separating certain metals and metallic substances from ores and other matters."

1406.—Edward Loysel, Manor House, Clapham, Surrey, "Improved apparatus for obtaining extracts from tea, coffee, and other vegetable substances."

1408. William Clark, Chancery Lane, Middlesex, "Improvements in the preparation of phosphates of ammonia and ammoniaco-magnesian phosphates."—A communication from Emmanuel Adrien Lesieur, Boulevard St. Martin, Paris.—Petitions recorded June 6, 1864.

1412. Henri Adrien Bonneville, Rue du Mont Thabor, Paris, France, "Improvements in telegraphic printing apparatus."—A communication from Victor Delaye, Rue de la Paix, Paris, France.

1418. Arthur Thomas Weld, Gravesend, Kent, and John Folliott Powell, Albion Place, Hyde Park, Middlesex, "Improvements in the separation of animal substances from rags of mixed fabrics."—Petitions recorded June 7, 1864.

1425. Thomas Richards, Wincanton, Somersetshire, "Improvements in liquid manure and water carts."

1426. Ferdinand Henry Warlich, Maze Hill, Greenwich, Kent, "Improvements in the manufacture of artificial block fuel and coke, and in apparatus employed therein."—Petitions recorded June 8, 1864.

1438. Napoleon Sarony, Birmingham, Warwickshire, "Improvements in the production and treatment of photographic portraits or pictures."—Petition recorded June 9, 1864.

1447. Charles William Siemens, Great George Street, Westminster, "Improvements in apparatus for producing combustible gases, part of which improvements are applicable for indicating the pressure of gases and fluids generally."—Petition recorded June 10, 1864.

1452. Peter Spence and John Berger Spence, Newton Heath, Lancashire, "Improvements in calcining and smelting copper ores."—Petition recorded June 11, 1864.

1456. William Sharp, Burgley, Yorkshire, "Improved means or apparatus for purifying and increasing the illuminating power of gas."

1458. John McElroy, Stretford, Lancashire, "Improvements in electro-telegraphic apparatus and in instruments for preparing the transmission of electric telegrams."—Petitions recorded June 13, 1864.

1486. Robert Whiteside, North Egremont, Cheshire, "Improvements in preserving iron ships and ships' sheathing from corrosion and fouling, and in apparatus to be employed therefor."—Petition recorded June 15, 1864.

Notices to Proceed.

338. William Culley Stobart, Etherley, Durham, "Improvements in coke ovens."—Petition recorded February 9, 1864.

355. Thomas Vincent Lee, Macclesfield, Cheshire, "Improvements in the construction of kilns or retorts for coking, and for apparatus connected therewith for collecting the products of distillation through the agency of hydro-caloric or superheated steam, these appliances being applicable to making wood, charcoal, and collecting pyroligneous acid during the process."

357. Jean Marius Faget, Bordeaux, France, "Improved

apparatus for taking up the emanations and the gases from boilers."

360. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of superphosphates to be employed in the making of bread and in other purposes in the arts."—A communication from Anthony Pollak, Washington, U.S.—Petitions recorded February 11, 1864.

432. Frederick John Arnold, Adam's Court, Old Broad Street, London, "Improvements in apparatus for producing and burning combustible gases for heating and lighting purposes."—A communication from Thomas Arnold, New York, U.S.—Petition recorded February 19, 1864.

472. Jean Francois Rivier, Boulevard de Strasbourg, Paris, France, "An improved system for filtering and purifying liquids with an endless spouting capillary filter."—Petition recorded February 25, 1864.

634. John Platt and William Richardson, Oldham, Lancashire, "Improvements in machinery or apparatus for breaking up or pulverising clay for the manufacture of bricks or other such articles, or for breaking up or pulverising other material."

635. Raymond Fletcher, Siddall's Road, Derby, "A new compound used for varnishing paperhangings and other articles."—Petitions recorded March 12, 1864.

674. Richard Archibald Brooman, Fleet Street, London, "Improvements in treating vegetable textile matters, in separating filamentous matters therefrom, and the application of such matters to spinning, weaving, and dyeing."—A communication from E. M. F. Bonneau, A. Dumont, and N. J. C. Canoby, Paris, France.—Petition recorded March 16, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, June 28, 1864.

As your readers, in common with all the other inhabitants of Great Britain, take the greatest possible interest in the weather, I cannot do better than begin my letter with that topic. For the last fortnight the temperature has been at fever heat, and the consumption of ices has been correspondingly high. On Sunday, however, to the delight of everybody, even of the holiday makers, the rain came down in torrents, and agreeably cooled the air: It is, perhaps, as well for you that the heat has moderated, for when the thermometer rises to such a pitch as it did last week, and stops there so long, there is an irresistible temptation to explore the woods round Vincennes (which, by the way, are almost denuded of their foliage by caterpillars) in search of botanical specimens, which somehow always die before one gets home, or ransack the quarries of St. Denis for fossils, which are always left behind, instead of attending hot lectures or writing letters with the perspiration bedewing the paper.

The subject of the sun leads one directly to photography. At the last meeting of the Photographic Society the Abbé Laborde read a paper on the "Reproduction of Kaleidoscopic Figures." I have always imagined that the great beauty of these figures resided in their colour, and to what end, therefore, should they be photographed? M. Laborde says these photographs would be useful to designers, but I fancy no decorative artist would be worth much who would seek the aid of the kaleidoscope for his patterns. M. Van Monckhoven read a paper on a new enlarging camera, which he has just perfected. The specimens exhibited are certainly the best enlargements yet seen, and by using a large lens of 19 inches in diameter for collecting the rays, an excellent positive may be taken on common albumenised paper in from twelve to fifteen minutes.

The Abbé Moigno, the esteemed editor of *Les Mondes*, has commenced giving monthly lectures to the subscribers to that journal, detailing the progress made in the different

branches of science during the past month. The first meeting, which was held on the 9th of June, was so great a success that the room in which it took place proved too small, and the Abbé was obliged to petition the *Société d'Encouragement* for the use of their large hall in the Rue Bonaparte for the July meeting. Several new scientific inventions were shown. One of the most interesting was the stethoscope exhibited by Kœnig, which consists of a sort of box containing an artificial tympanum of india-rubber. The apparatus is laid on the chest of the patient, and the sounds of the heart and lungs are listened to through five or six india-rubber tubes provided with ear-pieces. Thus, in the case of hospital demonstration, the patient is freed from the inconvenience of having half-a-dozen hard stethoscopes pushed into his chest, and the students around hear the sounds produced at their ease.

Runkorff has deservedly been presented with the Napoleon III. prize of 50,000 francs for the induction apparatus that bears his name. The King of Hanover has also sent him a large gold medal.

The Museum of Natural History has received several specimens of the meteorite that passed over this country on May 14. Had this happened in England, the specimens would have been visible to the public only about ten years afterwards.

The sericulturists, having tried almost every possible remedy for the numerous ills that silkworm flesh is heir to, have now taken to electrifying their interesting patients, with, it is said, excellent effect. The idea has originated with M. Sauvageon, and has been tried at Valence.

The Association for the Advancement of Astronomy and Meteorology, founded by M. Lavoisier, is making great way. At the last meeting, held at the *Observatoire*, a new reflecting telescope with a speculum 0.80 metres in diameter was shown, and the process of silvering explained. The foundation of such societies will do much to render science really popular in Paris. The popular ignorance of scientific subjects amongst even highly educated Parisians is most singular. It is true they have no Royal Institution, or even Polytechnic, such as we have, but science of a very high kind enters into the educational courses carried on in French schools to a much greater extent than in ours.

Amongst the papers recently read before the *Société Stanislas*, at Nancy, was one by MM. Giles and Durant, on the utilisation of the rags of mixed fabrics, that is, of rags whose woof is cotton and the weft woollen, or *vice versa*. It will be remembered that the general system pursued in England is to rot out the cotton by a weak acid or alkali, which leaves the wool intact. In such cases the cotton was lost, and a few years since Mr. F. O. Ward took out a patent for carbonising the wool by means of super-heated steam, which converted it into a valuable manure, leaving the cotton for paper-making. MM. Giles and Durant effect this by dissolving out the wool with the solution of an alkaline sulphide, the dissolved wool being available for the manufacture of prussiates. The authors of the paper were rewarded with the "Prix Ronfils." Amongst the other papers was one on a new green pigment of great beauty, which consists of manganate of barium.

The proceedings of the Atlantic Telegraph Company are looked upon over here with great interest. They will have a formidable rival in the Russo-American line, which, with the exception of about forty miles, will be a land line. Mr. Collins, an American, has lately obtained from the British and Russian Governments the right of passage through their territories for thirty-six years. Europe is already in momentary communication with Irkutsk, in Siberia. A line will consequently be laid from Irkutsk to the mouth of the Amour, thence along the coast of Asiatic Russia to over Behring's Straits, which is only about forty miles across, and so on through British North America and British Columbia to California, where the American network will be joined. An American Company has already

been formed to supply the capital necessary for carrying out the work.

M. Sauerwein has lately analysed one of the thousand-and-one anti-incrustation boiler compositions — impositions if you like to call them so — which are sold to ignorant manufacturers at fancy prices. It consists mainly of chloride of barium mixed with 15 per cent. of bone-black, possibly that which remains after the manufacture of sugar. It acts by precipitating sulphate of barium in an insoluble form. Considering the cheapness and efficacy of soda-ash for the purpose, it seems singular that manufacturers should run after so many quack compositions of all the colours of the rainbow.

Messrs. Cornelius and Baker, of the Franklin Institute, have recently devised a modification of the ordinary electrophorus for lighting gas. It consists of a spherical cup of brass lined with sheepskin and silk, into which drops a corresponding hemisphere of hard india-rubber. The brass cup communicates with a wire near the jet. To light the gas the hard rubber hemisphere is raised by means of a little handle, and the spark passes, lighting the gas in its passage. They have also devised a portable electrophorus of tubular construction. It consists of two brass tubes closed at each end, united together by a ring of hard rubber covered internally with a silk padding. Inside the tubes is a cylinder of hard rubber which passes freely down the tubes when they are reversed. The apparatus is grasped by the non-conducting ring and held upright, the hard rubber cylinder, of course, being at the lower end. Reversal causes it to pass to the other end, charging the brass tube in its passage.

Numerical Relations of Equivalent Numbers.

To the Editor of the CHEMICAL NEWS.

SIR,—I am not aware if the following fact has yet been noticed, viz., that the atomic weights of the elementary bodies are, with few exceptions, either exactly or very nearly multiples of eight:—

Li = 7	8
O = 16; N = 14	16 = 8 × 2
Mg = 24; Na = 23	24 = 8 × 3
S = 32; P = 31	32 = 8 × 4
Ca = 40; K = 39	40 = 8 × 5
Ti = 50	48 = 8 × 6
Ni = 58.5; Co = 58.5; Mn = 55; Fe = 56	56 = 8 × 7
Cu = 63.5; Zn = 65; Y = 64	64 = 8 × 8
Se = 79.5; Br = 80	80 = 8 × 10
Zr = 89.5; Sr = 87.5	88 = 8 × 11
Mo = 96; Di = 96	96 = 8 × 12
Ru = 104; Ro = 104	104 = 8 × 13
Cd = 112	112 = 8 × 14
Sn = 118; U = 120; Sb = 122	120 = 8 × 15
Te = 129; I = 127	128 = 8 × 16
Ta = 138; V = 137; Ba = 137	136 = 8 × 17
W = 184	184 = 8 × 23
Os = 199; Hg = 200	200 = 8 × 25
Pb = 207; Bi = 210	208 = 8 × 26
Th = 238	240 = 8 × 30

It will be observed that there are many of these which exactly agree with this law, viz.:—O = 16 = 8 × 2; Mg = 24 = 8 × 3; S = 32 = 8 × 4; Ca = 40 = 8 × 5; Fe = 56 = 8 × 7; Y = 64 = 8 × 8; Br = 80 = 8 × 10; Mo = 96 = 8 × 12; Di = 96 = 8 × 12; Ru = 104 = 8 × 13; Ro = 104 = 8 × 13; Cd = 112 = 8 × 14; U = 120 = 8 × 15; W = 184 = 8 × 23; Hg = 200 = 8 × 25; and others come very near. It is worthy of comment that elements having the atomic weights 72 = 8 × 9; 144 = 8 × 18; 152 = 8 × 19; 160 = 8 × 20; 168 = 8 × 21; 176 = 8 × 22; 192 = 8 × 24; 216 = 8 × 27; 224 = 8 × 28; and 232 = 8 × 29 are wanting, but future discovery may fill these vacancies.

Hoping you will excuse this intrusion on your time,
I am, &c. STUDIOSUS.

June 18, 1864.

A Sad Case.

To the Editor of the CHEMICAL NEWS.

SIR,—Before softening of the brain, which has already set in with uncontrollable vigour, renders me incapable of thinking or writing, permit me to ask your aid in rescuing at least some of my fellow creatures from the unfortunate fate that is about to befall me.

I was brought up under the old system of chemical notation, and believed that water was HO for many years, but having attended a certain lecture at the Royal Institution and another at the Chemical Society, advocating the claims of that interesting liquid to the style and title of H_2O , I was so far struck by the logical correctness of the views held by the lecturers that I forthwith vowed to inquire into the subject, and set the doubts raised in my mind at rest, one way or the other. The result of reading every article in all the leading scientific journals of Europe and America has been my entire conversion to the new faith, but, I am sorry to say, at the expense of my reason.

This lamentable result of my search after truth has not been brought about by any difficulty in grappling with the arguments adduced, but simply because scientific writers will not adopt one uniform system in formulating compounds. The confusion resulting is something chaotic. Talk about Mr. Babbage being driven mad by organ grinders! Let him only try to read and understand half-a-dozen consecutive articles on organic chemistry in any current scientific periodical. Or, to go no further, look at water. One writer formulates water HO, another H_2O , another H_2O , a fourth HO; in one page we find slaked lime appearing as CaO.HO in the next CaO.HO, a few lines further on CaHO, then CaHO, then CaH_2O_2 , then CaH_2O_2 , until the brain first becomes confused, then swims, and finally softens.

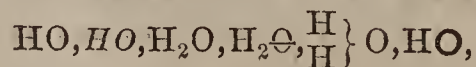
I don't think the blame in this case attaches so much to the editors of these journals as to the authors of the papers, who, from thoughtlessness, imagine that their readers will estimate the symbols they use at the same value that they do themselves. I appeal, therefore, most earnestly to scientific writers to allow their formulæ to be printed in such a manner as to be intelligible to every one. At one time this was accomplished by the double equivalents being indicated by a crossed letter—e.g., $\text{C}^{\times} = 12$, but this custom gradually gave way, and now no warning whatever is given that the C's, O's, &c., in particular papers, are doubled. Watts, in his magnificent "Dictionary of Chemistry," uses ordinary Roman capitals for the new formulæ, and italics for the old; but now that a third system has sprung up, in which the equivalents of calcium, iron, lead, &c., are doubled, this method will no longer serve. Why should not writers and editors agree, at any rate for the present, to use a thickened letter for the doubled equivalent; this would do away with all confusion, and possibly restore my unfortunate brain to its normal hardness. I give an example:—

CaO HO = Hydrate of lime. Old system.
CaHO = " calcium. Gerhardt's system.
CaH₂O₂ = " " Latest system, as
adopted by Kopp, Williamson, Odling, &c.

The idea of the *heavy* equivalent would thus be at once indicated by the *heavy* appearance of the symbol.

My keeper is coming, so I must close my letter.—I am, &c.
AN INMATE OF HANWELL.

P.S.—My keeper posts this for me. I bribed him by giving him 6d. to regale himself with a glass of brandy and



or whatever it is.

[Our correspondent has reason: it would relieve editors of many anxieties if chemists could only agree upon the use of formulæ. Could not an international congress settle the question?—Ed. C. N.]

Aërial Rings.

To the Editor of the CHEMICAL NEWS.

SIR,—The interesting experiments of Mr. Tomlinson, referred to in your last number, having drawn attention to the above phenomena, I may be permitted to quote some extracts from my laboratory notebooks, bearing on the subject.

Firstly as to the explosion of gunpowder. We often observe partial and indistinct wreaths on the discharge of heavy ordnance, but on one occasion I saw a strikingly perfect example. Whilst in Paris, in 1855, I was standing near the guns on the Esplanade des Invalides during the firing of a royal salute. The air was quite still, and the entire smoke from one piece burst into a dense oval ring which rose slowly and unbroken for twenty or thirty yards until it melted away. It gradually expanded in diameter, with a marked, though not extremely rapid, rotatory motion. The lively spectators were loud in their exclamations as to its beauty and appropriateness to the occasion, presenting as it did the appearance of a wreath or coronal.

Again, when briskly boiling a portion of a soil with dilute nitro-hydrochloric acid in a glass flask, I have occasionally seen the same effect well produced. In such cases the liquid is apt to boil in starts, and sometimes for hours together, almost every burst of acid steam will form itself into an expanding and rapidly rotating ring, as perfect as those from the deflagration of phosphuretted hydrogen, only not so large or opaque. The flask I employed held about three pints; the neck was long and the mouth about five-eighths of an inch in diameter.

Lastly, as an example of movements, somewhat similar in appearance, I may mention that on fusing a silicate with carbonate of soda in a large platinum crucible at an intense red heat, dark, sharply-defined circular lines are produced on the surface of the liquid, moving spirally inward from the edge to a central point like the figures we see in chromatope slides. On removing the blow pipe flame this effect continues for some time, only reversed, the revolving lines opening out from the centre to the circumference where the cooling takes place most quickly.

I am, &c.

FREDERICK W. GRIFFIN, Ph.D.

Bristol School of Chemistry, June 20.

MISCELLANEOUS.

Danger in the Electric Light!—It will scarcely be believed that Mr. W. de la Rue was obliged to insure Willis's Rooms for 20,000*l.* before the electric light could be exhibited at his *soirée*, the office in which the premises were already insured having given the proprietors notice that the company would not hold themselves liable for any damage by fire while the electrical apparatus remained in the building. The ignorance which stimulated this proceeding on the part of the company is something so extraordinary, that, out of charity to other offices, the name should be published. We may mention here that some offices have recently refused to insure buildings in which an apparatus was used for naphthalising gas.

ANSWERS TO CORRESPONDENTS.

J. A. M.—We do not think it can be done in any way.

D. L. J. F.—A common spirit lamp fed with wood spirit will answer every ordinary purpose.

C. H. B., Lancashire.—Chemists have long ceased to hang their theories on pegs, and use brackets instead.

T. N.—The fixed oil is decomposed by heat. Distillation is effected at a temperature of about 600° F. Stearine and olein may be obtained by saponifying tallow with lime and then decomposing the soap with sulphuric acid. The two fats must then be separated by pressure.

Received.—Mr. Ellis.—Next week. We shall be glad to hear further from our correspondent.

SCIENTIFIC AND ANALYTICAL
CHEMISTRY.

Researches on Oxygen, by Dr. G. MEISSNER.

(Continued from page 3.)

THE following cuts were intended to accompany the abstract in our last number. Figure 1 will be easily understood as showing the arrangement of the tubes (described at page 2) for electrizing the surrounding air, and needs no further description. Figure 2 represents

the apparatus (mentioned at page 3) used by the author for completely drying the air, as well as the ozonising tube and the flasks in which he experimented with the ozonised air. The air from the gasometer first entered the tube *a*, filled with chloride of calcium, and then passed through the flask *e*, which contained English oil of vitriol. By noticing the bubbles as they passed through this flask the rapidity of the current could be seen, and regulated accordingly. From the flask the air passed through the tubes *b*, *b*, *b*, filled with fragments of glass drenched with sulphuric acid; and, finally, before reaching the ozonising tube, through the bent tube *c*, which

FIG. 1.

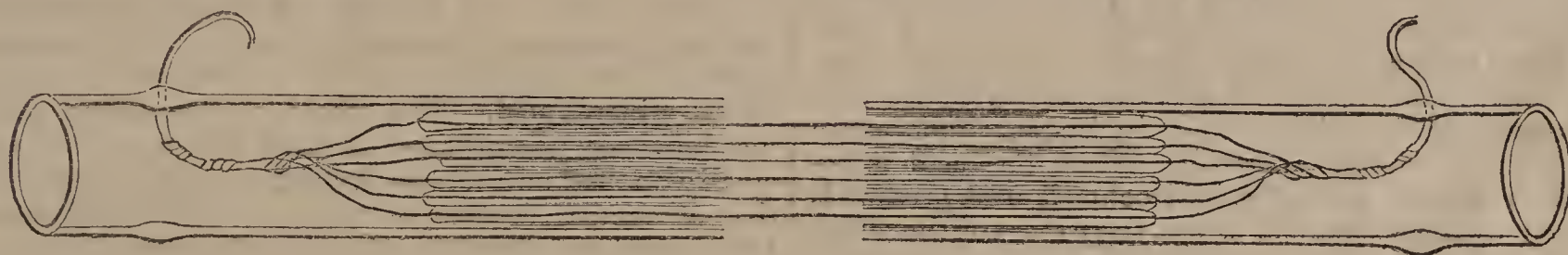
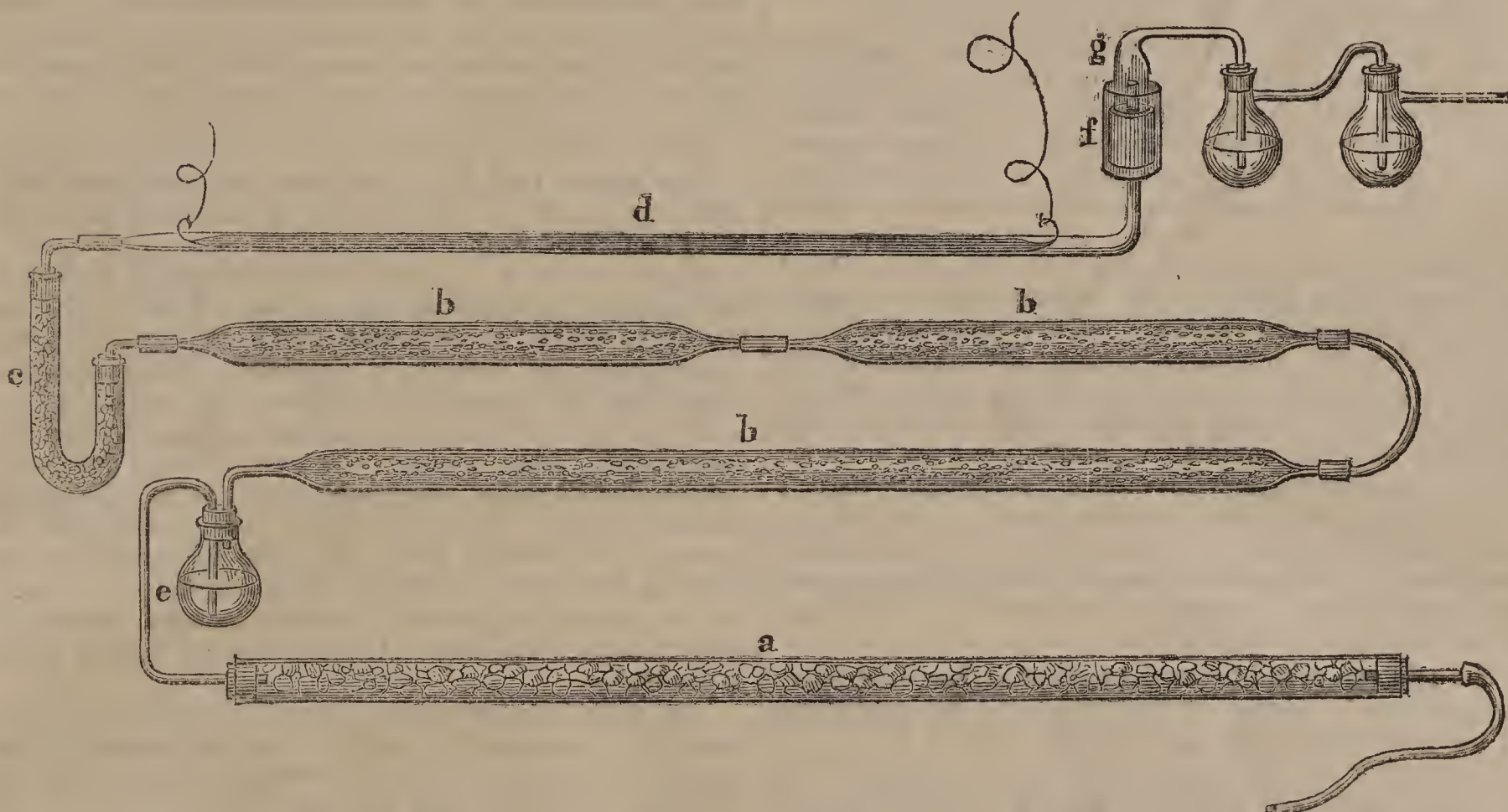


FIG. 2.



contained pieces of marble to retain any sulphuric acid. The exit end of the ozonising tube is seen to be bent up and pass through a cork into a larger tube, *f*, where it is surrounded with mercury. A small bell glass or a bent neck of a retort, *g*, dips into the mercury and conducts the ozone to the flasks for experiment.

We may now continue our account of the author's results.

The cloud or smoke which forms as the ozonised air passes through water, remains on the surface of the liquid, and when the vessel is full and the air of the laboratory is still, may be poured out like carbonic acid. If poured through a tube to the bottom of a dry glass vessel it displaces the air, and the vessel may be filled with the cloud. When a vessel so filled is closed and set aside the mist gradually becomes less opaque, and in the course of thirty or forty-five minutes quite disappears,

leaving the air quite transparent. Water, however, is slowly deposited on the sides of the vessel in small drops or dew, which aggregates and flows to the bottom.

When the mist has once disappeared it is impossible to reproduce it with more water, and the air which remains has only the properties of the ordinary atmospheric mixture. The atmizone, therefore, has changed into ordinary oxygen. The water may be perfectly pure, or it may contain substances carried along by the cloud, as will be explained later.

These results prove that atmizone has the property of attracting moisture and giving it the characters of a cloud or mist, and then of depositing it again in the form of droplets or dew, while it is itself changed into ordinary oxygen.

(To be continued.)

*On a Colloid Acid; a Normal Constituent of Human Urine, by WILLIAM MARCET, M.D., F.R.S.**

THE present communication describes the mode of extraction and the properties of an acid of a colloid nature which is always present in healthy human urine, and appears destined to become of great importance in physiological chemistry.

With the view of separating this acid from the urinary secretion, the fluid is mixed with animal charcoal, concentrated, filtered, and the filtrate, after precipitation with baryta-water, is dialysed for about twenty-four hours. The dialysed liquid, after subsequent filtration and concentration, is mixed with basic acetate of lead, which precipitates the colloid acid as an insoluble lead-salt, along with a little hydrochloric acid and other impurities. The precipitate should be thoroughly washed, decomposed with sulphuretted hydrogen, and again treated with animal charcoal. When the acid is required in a pure state, the hydrochloric acid present is removed with carbonate of silver, the excess of the silver precipitated with sulphuretted hydrogen, and after boiling to evolve this last substance, basic acetate of lead is again added. The lead-salt perfectly washed may be considered pure, and the pure acid can be obtained from it by decomposition with sulphuretted hydrogen.

The acid is very slow to decompose when exposed to the air. It may be considered to undergo no loss or decomposition by being boiled, as shown by direct experiment. After concentration by heat, its colour darkens, and it becomes syrupy, possessing a sharp acid taste, with a slight acrid and astringent after-taste; the taste is perceptible in the solution when very dilute: no crystals of the acid could be obtained in the syrup. Dried at a temperature under 212° F., the acid has the appearance of a transparent varnish; it is very hygroscopic, and dissolves readily in water, though not apparently in alcohol, sp. gr. .820, or in ether. When burnt, the colloid acid chars, emitting a pungent and irritating smell, and after complete combustion, nothing but the minutest trace of inorganic residue remains. Although strictly a colloid, this acid in the free state passes through a dialyser, but not so readily as a crystalloid. When under the form of a compound its property of dialysing appears much diminished. I could not find that it exerted any action on polarised light.†

The acid was found to consist only of carbon, hydrogen, and oxygen. I have not yet succeeded in establishing its ultimate quantitative composition, but it appears to be very poor in hydrogen and rich in carbon. The atomic weight of the substance was found by the analysis of its insoluble lead-salt, and of its baryta-salt. I determined the lead in the lead compounds from six different samples of urine; the average on 100 parts was 33.7 of acid. The analysis of the baryta compound yielded on 100 parts 27.8 of acid. Corresponding to the atomic weights—

for the lead compound	{ Oxide of lead . . .	111.5
	{ Acid . . .	56.7

168.2

for the baryta compound	{ Baryta . . .	76.5
	{ Acid . . .	29.5

106.0

It is therefore very obvious that the acid forms two

salts, an acid and a neutral salt. We shall adopt the number 28.35 [or $\frac{56.7}{2}$] for the atomic weight of the new

acid. The fact of there existing two different compounds of the acid explains many chemical phenomena exhibited by this substance and its salts.

The neutral salts of the acid are all soluble.

It forms two lead salts, one which is insoluble in water and containing two equivalents of acid, and one which is soluble in water, and evidently containing one equivalent of acid.

The insoluble compound is obtained by adding basic acetate of lead to an aqueous solution of the acid or of its neutral salts. An excess of the basic acetate redissolves the precipitate, which reappears on the addition of dilute nitric acid, to be finally redissolved in an excess of the mineral acid. The whole of the colloid acid is not, however, precipitated by basic acetate of lead, principally on account of the formation of a certain quantity of neutral acetate of lead, which I found to have the property of dissolving the insoluble colloid lead salt. On boiling a mixture of the insoluble lead compound with neutral acetate of lead, acetic acid was given off, a confirmatory proof of the insoluble lead compound being an acid salt. In this case one equivalent of the colloid acid combines with one equivalent of oxide of lead of the neutral acetate, two equivalents of the neutral lead salt of the colloid acid being thus formed.



This shows that it is not possible to estimate with accuracy the amount of the acid in urine by means of basic acetate of lead.

When the acid is boiled with an excess of hydrated oxide of lead, an insoluble compound is formed. If the acid be in excess, a compound soluble in hot water, but precipitating on cooling, is obtained. I have not yet determined the composition of these two lead salts.

The baryta and lime salts are easily prepared from the carbonates. They contain one equivalent of the acid, are soluble in water, and yield precipitates with basic acetate of lead, nitrate of silver, and protonitrate of mercury and tannic acid; the more concentrated the solution the more abundant the precipitates. A very slight precipitate occurs by adding neutral acetate of lead to salts of the acid. Other reagents fail to yield precipitates.

The acid dissolves silver from the carbonate, but I could not neutralise it perfectly by such means. The lime salt of the acid cannot be entirely decomposed by boiling it with carbonate of silver.

When the acid is boiled with black oxide of copper, copper is readily dissolved.

I endeavoured to determine approximately the quantity of the colloid in a given bulk of the urinary secretion, and extracted from 8 litres 4.46 grammes of this substance, which, however, must fall short considerably of the real amount of the acid present.

It may be considered as existing in all probability in the blood, where there is little doubt that it acts an important part in the phenomena of the secretion of gastric juice, by displacing the hydrochloric acid from chloride of sodium combining with the sodium. The soda salt would remain in the blood, being a colloid compound, while the free hydrochloric acid would find its way into the stomach. An experiment I performed in connexion with this subject bears out the present view.

The formation of the colloid acid appears to result from some transformation of the colloid, a non-nitro-

* Read before the Royal Society, June 16, 1864.

† This acid does not precipitate egg-albumen. It precipitates caseine, but an excess does not appear to redissolve the precipitate as in the case of acetic acid.

genous constituent of the liver known as the glucogenic substance. When better acquainted with the chemical composition and physiological relations of the colloid acid of urine I shall be able to give it an appropriate name.

Remarks on the Distillation of Substances of Different Volatilities, by M. CAREY LEA.

SOME experiments which have been recently published by M. Berthelot recal to me a similar and remarkable case which attracted my attention several years ago.

M. Berthelot distilled 92 parts of alcohol and 8 of water, and found that the distillate at the beginning, middle, and end of the operation contained equal quantities of water and of alcohol.

He distilled also a mixture containing a large quantity of sulphide of carbon and a small quantity of alcohol, and found that the least volatile body, the alcohol, passed over with the first portions of the distillate, so that towards the end of the operation the retort contained sulphide of carbon almost pure.

To these facts, which tend to cast the greatest doubt on all the results obtained by the laborious process of fractional distillation, I now add the following:—

When a mixture containing the chlorides of ethylamine, diethylamine, and triethylamine is distilled with caustic alkali, we should, according to received ideas, expect to find the ethylamine, which is a gas at ordinary temperatures, distil over first. Triethylamine, which is at ordinary temperatures and pressures a liquid, separates as such when a strong solution of its chloride is treated with caustic alkali, and floating on the surface, as I have before pointed out, we would naturally expect to find it principally in the later stages of the distillation. The contrary, however, is the case when the less substituted ammonias predominate in quantity. Almost the whole of the triethylamine passes over in the first portions of the distillate, and subsequent ones, though rich in ethylamine and diethylamine, scarcely contain a trace of triethylamine.—*American Journal of Science*, vol. xxxvii. p. 377.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

“On Chemistry Applied to the Arts.” By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

BONES.—Composition of raw and boiled bones. The manufacture of superphosphate of lime. Application to agriculture. Bone-black or char, and their use in sugar refining. Phosphorus, its properties, extraction, and employment in manufacture of matches. Horn and ivory, their composition and applications.

LECTURE I.

I SHALL not take up your time by making many preliminary remarks, but merely state that though the heads of the subject on which I intend to speak are not inviting ones, still we shall find as we progress that the study of the various matters which I shall bring before you is full of interest and instruction. Further, it would be difficult to name subjects which better illustrate the ability of man to turn to profitable account the various materials placed in his hands, or to mention substances which have received more complete and skilful applications than those we shall treat of this evening.

BONES.—The composition of “green bones,” or bones in their natural state, may be considered under two general heads, viz.:—the animal matters, consisting of a substance called osséine and a few blood-vessels, and the mineral matters, chiefly represented by phosphate of lime and a

few other mineral salts. The composition of bones has been examined by many eminent chemists, but the most complete researches are those, published in 1855, by M. Fremy, who examined bones, not only from various classes of vertebrated animals, but also from different parts of the same animal; and to enable you to appreciate some of his conclusions, allow me to draw your attention to the following table:—*

Composition of Bones.

Name of Bone.	Mineral Matter.	Phosphate of Lime.	Phosphate of Magnesia.	Carbonate of Lime.
Femur—Fœtus 6 months	63.0	58.9	..	5.8
„ Boy 18 „	61.6	58.0	0.5	2.5
„ Woman 22 years	60.1	59.4	1.3	7.7
„ Man 30 „	63.2	57.7	1.2	9.3
„ „ 40 „	64.2	56.3	1.3	10.2
„ Woman 80 „	64.6	57.1	1.2	7.5
„ „ 97 „	60.8	51.9	1.3	9.3
„ Lion (young) ..	64.7	60.0	1.5	6.3
„ Sheep	70.0	62.9	1.5	7.7
Sperm Whale	62.9	51.9	0.5	10.6
Ostrich	70.0	..	..	..
Carapace of Turtle..	64.3	58.0	1.2	..
Codfish	61.3	..	..	..
Stag's horn	61.9	58.1	traces	3.8
Cow's tooth Bone ..	67.1	60.7	1.2	2.9
„ „ Enamel ..	96.9	90.5	traces	2.2
„ „ Ivory ..	74.8	70.3	1.3	2.2
Scales of the Carp ..	34.2	33.7	traces	1.1

The first conclusion drawn by M. Fremy from these researches is, that he found a larger proportion of mineral matter than is generally admitted by chemists. Secondly, that there is no material difference in the composition of various bones taken from different parts of man, or of any one animal, but that age had a very marked influence on composition. Thus, in the bones of infants there is more animal and less mineral matter than in the adult, whilst in old age there is more mineral and less animal matter than in the middle-aged man. The mineral substance which chiefly increases in old age is carbonate of lime. Lastly, he could find no marked difference between the bones of man, the ox, calf, elephant, and whale; whilst in the bones of carnivorous animals and those of birds there is a slight increase in the amount of mineral matter. Allow me now to call your attention to a most interesting query. I hold in one hand the mineral matter only of a bone, which you can see retains perfectly its original form, and in the other hand I have the animal matter only of a similar bone, which also retains the form in which it previously existed, but is flexible instead of rigid. The question, therefore, arises, whether the strength and hardness of bones proceed from these two kinds of matter being combined together, or are their respective molecules merely juxtaposed? The answer is, the latter; for, as you see by this specimen, the mineral matter has been entirely removed without deforming the animal texture. Further, in the fœtus it is found that the bones contain nearly the same proportions of animal and mineral matters as those of the adult. Also, it has been observed by M. Flourens and other eminent physiologists, that the wear and tear of bones during life is repaired by the formation of new bone on the exterior surface of the bone, while the old substance is removed through the interior duct, and that the composition of the new layer is the same as that of the original bone. Let us now proceed to examine the chemical properties of the various substances composing bones, and some of the various applications which they receive in arts and manufactures. The general composition of bones may be considered to be as follows:—

BONES.

Organic Substances.	Blood-vessels	1
	Osséine	32
	Fatty matters	9

* *Annales de Chimie et Physique*, volume 43, pages 79, 83, 84.

Mineral Substances.	Water	8
	Phosphate of lime	38
	Phosphate of magnesia	2
	Carbonate of lime	8
	Various salts	2
		100

The above-named animal matter, *osséine*,—

C	50.4
H	6.5
N	16.9
O	26.2

and which has been erroneously called gelatine, is insoluble in water, weak acids, and alkalies, whilst gelatine presents properties directly reverse. But what has led to this popular error is that *osséine*, when boiled in water, becomes converted into the isomeric substance commonly called gelatine. As I shall have to dwell on this substance at some length in my next two lectures, I will not detain you now further than to state that *osséine* is obtained from bones by placing them in weak hydrochloric acid, which dissolves the phosphate of lime and other mineral salts, washing the animal matter (*osséine*) until all acid is removed, drying it, and treating it with ether to remove fatty matters. I cannot leave this subject without remarking on the extraordinary stability of this animal substance, for it has been found in the bones of man and animal after many centuries, and even in small quantities in fossil bones.

The fatty matter of bones is made useful in the manufacture of soap, railway grease, and in other purposes; it is obtained by taking fresh bones (as bones which have been kept a long time will not yield their grease easily) and placing the spongy parts, or ends of the bones (where most of the fatty matter exists) in large boilers filled with water, which is then carried to the boil, when a part of the *osséine* is converted into gelatine, and the fatty matter liberated, which rises to the surface, and is easily removed. The bones thus treated are called boiled bones, and receive many important applications, to which your attention will be called in a few minutes. Benzine and bisulphuret of carbon have been used as substitutes for water in the above operation, but the advantages do not seem to have been sufficient to lead to their general adoption.

Mineral Matter of Bones.—These, as the foregoing tables show, are chiefly represented by phosphate and carbonate of lime. The immortal Berzelius was the first to establish the fact that phosphate of lime was the only substance possessing the properties necessary for the formation of bone, owing to the extremely simple chemical reactions which cause the soluble phosphates to become insoluble. Let us trace shortly the sources from whence we derive the large proportion of phosphate of lime which exists in our frames. Several of our most eminent chemists have proved the existence of phosphorus in sedimentary and igneous rocks, and the important part played by phosphorus in nature cannot be better conveyed to your minds than by this extract from Dr. Hofmann's learned and valuable Report on the Chemical Products in the Exhibition of 1862:—"Large masses of phosphorus are, in the course of geological revolutions, extending over vast periods of time, restored from the organic reigns of nature to the mineral kingdom by the slow process of fossilisation; whereby vegetal tissues are gradually transformed into peat, lignite, and coal; and animal tissues are petrified into coprolites, which in course of time yield crystalline apatite. After lying locked up and motionless in these forms for indefinite periods, phosphorus, by further geological movements becomes again exposed to the action of its natural solvents, water and carbonic acid, and is thus restored to active service in the organisms of plants and

lower animals, through which it passes, to complete the mighty cycle of its movements into the blood and tissues of the human frame. While circulating thus, age after age, through the three kingdoms of nature, phosphorus is never for a moment free. It is throughout retained in combination with oxygen, and with the earthy or alkaline metals for which its attraction is intense." After these eminently philosophical views by Dr. Hofmann, I will proceed to call your attention to the application of bones to agriculture. Bones are generally used for manuring in one of these three forms,—1st. As ground green bones; 2nd. As ground boiled bones—(that is, bones nearly deprived of their *osséine* by boiling under pressure, as I shall describe in my next lecture); 3rd. Superphosphate of lime.

Green or raw bones have been used on grass land for a long period, but their action is exceedingly slow and progressive, owing to the resistance of the organic matter to decomposition and the consequently slow solubility of the phosphate of lime in carbonic acid dissolved in water. What substantiates this view is that boiled bones are far more active than the above. It is found that 30 to 35 cwts. per acre of these will increase the crops on pasture land from 10 to 20 per cent. in the second year of their application. But the great advantage which agriculture has derived from the application of bones as a manure has arisen from their transformation into superphosphate of lime, especially applicable to root and cereal crops. To Baron Liebig is due the honour of having first called the attention of farmers (in 1840) to the importance of transforming the insoluble phosphate of lime of bones into the soluble superphosphate, rendering it susceptible of immediate absorption by the roots of plants, and of becoming at once available for their growth. These suggestions of Liebig were rapidly carried out on a practical scale by Messrs. Muspratt, of Lancashire, and J. B. Lawes, of Middlesex; and in consequence of the valuable results obtained by them, the manufacture of artificial manures has gradually grown into an important branch of manufacture in this country. The manufacture of superphosphate of lime is so simple that any farmer possessing a knowledge of the mere rudiments of chemistry can make it for himself, by which he will not only effect great economy, but also secure genuineness of product. All he requires is a wooden vessel lined with lead, into which can be placed 1000 lbs. of ground boiled bones, 1000 lbs. of water, and 500 lbs. of sulphuric acid sp. gr. 1.845 (or concentrated vitriol), mixing the whole, and stirring well for about twelve hours. After two or three days a dry mass remains, which only requires to be taken out and placed on the land by means of the drill, or to be mixed with water and sprinkled on the land. When very large quantities of this manure are required, the plan devised by Mr. Lawes appears to me the best suited. It consists in introducing into the upper end of a slightly-inclined revolving cylinder a quantity of finely-ground boiled bones, together with a known proportion of sulphuric acid of sp. gr. 1.68. As the materials slowly descend by the revolution of the cylinder they become thoroughly mixed, and leave it in the form of a thick pasty mass, which is conducted into a large cistern capable of containing 100 tons, or a day's work. This is allowed to remain for twelve hours, when it is removed, and is ready for use. Most manufacturers find it necessary to add to the phosphate of lime of bones other sources of phosphates, such as coprolites, or the fossil dung of antediluvian animals, which have been found in large quantities in Suffolk, Cambridgeshire, and elsewhere, and contain from 36 to 62 per cent. of phosphate of lime, and from 7 to 38 per cent. of organic matter. Others employ a mineral substance called apatite, containing about 92 per cent. of phosphate of lime, and found also in large quantities in Spain, Norway, France, &c. Others, again, employ guanos rich in phosphate of lime, such as those of Kooria Moorla Islands

and Sombrero phosphates. The following is the average composition of the superphosphate of lime of commerce:—

Soluble phosphate	. . .	22 to 25 per cent.
Insoluble „	. . .	8 „ 10 „
Water .	. . .	10 „ 12 „
Sulphate of lime .	. . .	35 „ 45 „
Organic matter .	. . .	12 „ 15 „
Nitrogen, 0.75 to 1.5 per cent.		

The valuable and extensive researches of Messrs. Lawes and Gilbert and Messrs. Boussingault and Ville have not only demonstrated the importance of phosphates to the growth of cereal and root crops, but also that phosphates determine, in a great measure, during vegetation, the absorption of nitrogen from the nitrates or from ammonia, as will be seen by the following table:—

Amount of Nitrogen fixed by Wheat under the Influence of following Salts:—

	Without nitrogenated compounds.	With nitrogenated compounds.
Phosphate of lime and alkali- line silicate . . .	8.15	20.08
Phosphate of lime . . .	7.25	19.17
Earths and alkaline silicates . . .	5.71	11.16
Earth . . .	3.00	9.50

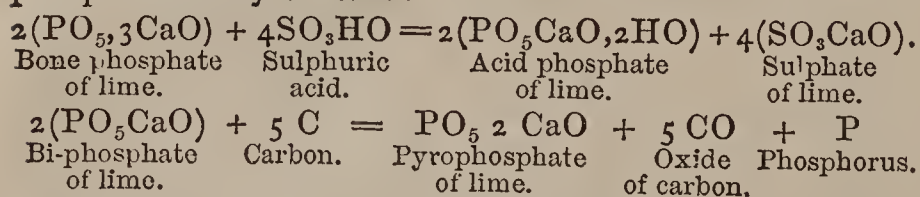
Bone-black or Char.—In 1800 Löwitz made the interesting observation that wood charcoal possessed the remarkable property of removing colouring matters from their solutions. In 1811 Figuier also observed that animal black had far greater decolorating power than wood charcoal, and bone-black has consequently become one of the principal agents in sugar-refining, and has been the means, more than any other substance, of producing good and cheap white sugars. To give you an idea of the extent to which bone-black is used at the present day for decolorating purposes in the refining of sugar, I may state that in Paris alone it is estimated that about 11,000,000 kilogrammes of bones are used annually for that purpose. The preparation of bone-black is simple in principle. It consists in placing in cast-iron pots about 50 lbs. of broken boiled bones, that is, bones which have been deprived of their fat—of most of their osséine, and piling these pots in a furnace, where they are submitted to a gradually rising temperature during twenty-four hours, such as will completely decompose the organic matter, but not so high as to partly fuse the bones and thus render them unfit for their applications. But a more economical process is generally adopted. It consists in introducing the crushed bones into horizontal retorts, which are themselves in connexion with condensers, the ends of which are brought under the retorts to assist by their combustion in the distillation of the animal matter. By this arrangement not only is char obtained, but oily matters which are used by curriers, and also ammoniacal salts employed in agriculture and manufactures. The extraordinary decolorating action of animal blacks may be considered as partly chemical and partly mechanical—mechanical because it is proved, by some interesting researches of Dr. Stenhouse, to which I shall refer further on, that the action is due to the minute division of the carbon and the immense surface offered by its particles to the colouring matter, char being composed of 90 parts of mineral salts to 10 per cent. of carbon. On the other hand, the action is proved also to be chemical, by the fact that water will not remove the colouring matter, whilst a weak solution of alkali will dissolve it. Dr. Stenhouse's valuable researches not only illustrate fully this fact, but also prove the possibility of producing artificially substitutes for bone-black. In 1857 he published a paper describing the production of an artificial black, called by him aluminised charcoal. This he obtained by mixing intimately and heating finely pulverised charcoal and sulphate of alumina, when he obtained a powerful decolorating agent containing 7 per cent. of alumina, and well adapted for decolorating acid solu-

tions, such as those of tartaric and citric acids, in chemical works. He also prepared what he called coal-tar charcoal by melting one pound of pitch in a cast-iron pot, adding to it two pounds of coal-tar, and mixing intimately into it seven pounds of hydrate of lime, then carrying the whole to a high temperature, allowing it to cool, and removing the lime by washing the mass with hydrochloric acid and then with water, when carbon in a high state of division was obtained, possessing powerful decolorating properties. The following series of experiments by Dr. Stenhouse perfectly illustrate the chemico-physical action of animal black as a decolorating agent. He boiled a certain amount of char and his two charcoals with a solution of logwood, then treated each black separately with ammonia, when the following results were obtained:—Aluminised charcoal yielded no colour; bone-black but a slight amount; coal-tar charcoal large quantities. But it would be wrong in me to leave you under the impression that animal black can only remove colours from solutions. Purified animal black—that is to say, animal black deprived of its mineral matters by the action of muriatic acid and subsequent washing—has the power of removing certain bitters from their solutions. Thus Dr. Hofmann and Professor Redwood applied this property with great skill some years ago to the detection of strychnine in beer. Again, Thos. Graham, Esq., Master of the Mint, published a most interesting series of researches, in which he established the fact that purified animal black had the power to remove a great number of saline matters from their solutions, such as the salts of lime, lead, copper, &c.

Revivification of Bone Black.—After a certain quantity of syrup sugar has percolated through the cylinders containing bone-black, the interstices become so clogged with impurities that it loses its power of decolorating the syrup. Sugar refiners are therefore in the habit of restoring the power of their bone-black, generally speaking, by submitting it to a process of calcination, which volatilises or destroys the organic matter fixed by the char. It has been proved by experience that char may undergo this operation about twenty times before its pores become so clogged with dirt as to render it useless. [Here the lecturer described, with the aid of drawings, several of the various apparatus used in sugar refineries for the above process, alluding particularly to that of Messrs. Pontifex and Wood, by which a ton of char is revived every twenty-four hours.] A new process, however, has been devised by Messrs. Leplay et Cuisinier, which as a whole deserves the attention of refiners, though I am aware that several of the details of their process have been used for some time. The char which has served its purpose in the cylinders, instead of being removed, is treated at once by the following processes:—It is first thoroughly washed, treated by steam to remove all viscous substances, then a weak solution of alkali is allowed to percolate through the char, which removes saline matters and a certain amount of colouring matter, when it is further acted upon by weak hydrochloric acid, which, in removing a certain amount of the lime salts, liberates the colouring matter; the char is again washed with weak alkali to remove the remaining colouring matter, and lastly the decolorating power of the black is restored by passing through it a solution of bi-phosphate of lime. It is to be hoped that the high praise bestowed upon this process on the Continent may induce our manufacturers to try it, as they would obtain two distinct advantages by its use. First, the economy of operating at once upon the black and restoring its properties without removing it from the cylinders. Secondly, the prevention of the noxious odours given off during the revivification of char by the ordinary methods. It is interesting to note one of the results of the different employment of char in this country and on the Continent. In England the wear and tear in sugar refinery is constantly repaired by the introduction of fresh char, and there is no spent or old char for sale. In France, on the

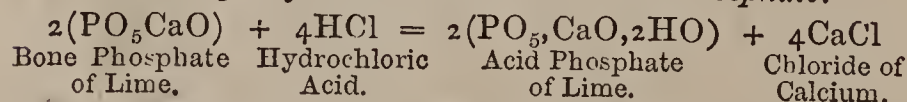
contrary, owing to the great impurities in their beet-root sugar syrups, and to the use of blood in refinery, the char becomes rapidly clogged with organic matter, and is so completely animalised, that its value as a manure exceeds what the char originally cost the refiner. The result is that French "spent" char is annually exported to the French colonies to the amount of 120,000 tons, and is there used as a manure to promote the growth of the sugar cane. So important is this article of commerce considered, that the French Government have appointed special analytical chemists to determine its value for the trade.

Phosphorus.—I am now about to call your attention to one of the most marvellous and valuable substances ever discovered by chemists. In 1660, Brandt, a merchant of Hamburgh, discovered a process for obtaining phosphorus from putrid urine; but though he kept his secret, a chemist named Künckel published the mode of obtaining it from this fluid. A hundred years later, Gahn discovered the presence of phosphorus in bones; and Scheel shortly afterwards gave a process to obtain it therefrom. The process devised by this eminent chemist was shortly afterwards improved upon by Nicolas and Pelletier, and their method was so completely worked out by Fourcroy and Vauquelin, that it is still the process used in the present day. The preparation of phosphorus consists of four distinct operations:—1st, 80 parts of thoroughly-calcined and pulverised bones are mixed with 80 parts of sulphuric acid, sp. gr. 1.52, to which is then added 400 parts of boiling water; 2ndly, after a few days the clear liquor, containing bi-phosphate of lime, is removed from the insoluble sulphate, and evaporated until it has the specific gravity of 1.5; 3rdly, this liquor is mixed with 20 per cent. of finely-pulverised charcoal, and the whole is dried at a moderately high heat; when, 4thly, it is introduced into an earthenware retort, placed in the galley furnace, and, on heat being slowly applied, phosphorus distils, and the operation is continued at a high heat for several days. It is, however, necessary that the phosphorus thus obtained should be purified, and this is effected by melting the phosphorus under water, and pressing it through a chamois skin. It is then boiled with caustic alkali to remove other impurities, but what is still better is to heat the phosphorus with a mixture of bichromate of potash and sulphuric acid. The phosphorus thus purified is drawn through slightly conical glass tubes by the suction of a caoutchouc pouch, or is allowed to run, by an ingenious contrivance, into tin boxes. As will be seen by the following formula, the manufacturer only obtained from the bones one-half of the phosphorus they contain:—

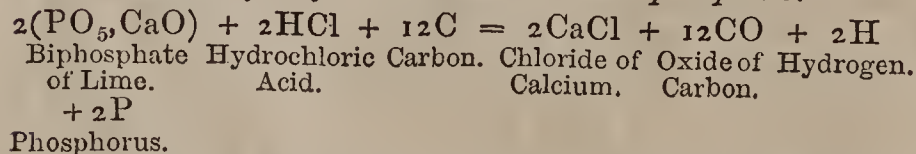


Consequently many attempts have been made to devise a chemical reaction by which the whole of the phosphorus might be secured. The most successful attempt of late years is that made by Mr. Cary-Montrand, whose process is based on the following chemical reaction:—

Action of Hydrochloric Acid on Bone Phosphate.



Action of Hydrochloric Acid on Biphosphate.



He arrives at this result by treating calcined bones with hydrochloric acid; the liquor is then mixed with charcoal, and the whole dried at a moderate heat. The prepared mass is then introduced into cylinders through which a

stream of hydrochloric acid is made to percolate, and, as shown above, chloride of calcium, hydrogen, carbonic oxide, and two proportions of phosphorus are produced. (The process of Fleck was also described.) Phosphorus prepared and purified by the above processes is a solid, semi-transparent body, having a sp. gr. 1.83, fusing at 110.5° F., and boiling at 550°. It is so inflammable that it ignites in the open air at several degrees below its fusing point; but Professor Graham made, some years ago, the interesting observation that this slow combustion of phosphorus could be entirely checked by the presence of certain combustible vapours. Thus he found that one volume of vapour of naphtha in 1820 of air, or one volume of vapour of oil of turpentine in 4444 of air completely prevented the spontaneous combustion of phosphorus. Further, phosphorus presents the curious property that, if heated to 160° F. and suddenly cooled, it becomes black, and if heated to 450° or 460° for several hours it becomes amorphous, and of a dark brown colour. This allotropic state of phosphorus, first noticed by Schrotter, has enabled it to render great service to society, owing to its not being spontaneously inflammable (as, in fact, it only becomes so at a temperature approaching its point of fusion), and also to its not being poisonous, so that it can be substituted for common phosphorus in the manufacture of matches with great advantage. Lastly, owing to this brown amorphous phosphorus not emitting any vapours, those employed in the manufacture of chemical matches now avoid the risk of the dreadful disease of the jaw-bone, called phospho-necrosis. Notwithstanding the great difficulties attending the manufacture of this valuable product, Mr. Albright, of Birmingham, has, with praiseworthy perseverance and great skill, succeeded in obtaining it perfectly pure on a large scale, and at such a price as to bring it within the scope of commercial transactions.

Chemical Matches.—Although I do not intend to enter at great length upon this subject, yet, as it is a highly important one, I deem it my duty to lay a few facts before you. The first application of chemistry to the discovery of a substitute for the old tinder-box of our fathers, was made in 1820, when the sulphuretted ends of matches were covered with a mixture of chlorate of potash, lycopodium, and red lead, and the matches so prepared were dipped into asbestos moistened with sulphuric acid. In 1836, lucifer matches were first introduced, and the explosive matches were soon followed by the non-explosive ones. The composition of these matches is as follows:—

	Non-Explosive.	Explosive.
Phosphorus	25 or 30	9 or 4
Red lead	5 „ 20	16 „ 3
Nitre	0 „ 0	14 „ 10
Sand	20 „ 20	
Vermillion	1 „ 0	
Gum or glue : . . .	20 „ 25	16 „ 6

The danger as well as the disease attendant on this manufacture was greatly mitigated by Professor Graham's discovery of the property of turpentine vapour already alluded to. Until lately the only successful application of amorphous phosphorus to lucifer matches was that of Messrs. Coignet, Frères, of Paris, who caused a rough surface to be covered with it, and so prepared their matches that they would not ignite except when rubbed upon the prepared surface. Similar matches, under the name of "special safety matches," have also been introduced into this country of late by Messrs. R. Letchford and Co., who have also effected several important improvements in this branch of manufacture, in one of which paraffine is made use of to carry combustion to the wood, instead of sulphur, which gives rise to the noxious fumes of sulphurous acid, and as the substitution is made by Messrs. Letchford without any increase of cost, the price of these matches is as low as that of the common ones. These gentlemen have also found the means of diminishing

the amount of phosphorus used to a very considerable extent, so that the disagreeable smell of this substance is also avoided. But the greatest improvement that Messrs. Letchford have made is in what they call their hygienic matches, or lights, in which, for the first time, amorphous phosphorus is substituted for ordinary phosphorus, and in small quantities. The advantages of these matches cannot be overrated, for children can eat them with impunity, as amorphous phosphorus is not poisonous; they are not nearly so combustible, and, therefore, not so likely to cause accidental fires; and lastly, all source of injury to the health of those employed in the manufacture is removed. I cannot leave this subject without still drawing your attention to one or two important facts. Messrs. Hochstetter and Canouil, besides others, have lately introduced chemical matches free from phosphorus, which are stated to have the following composition:—

Chlorate of potash . . .	10	10	10
Hyposulphide of lead . . .	26	26	20
Peroxide of lead . . .	—	9.8	—
Peroxide of manganese . . .	—	—	33.6
Chromate of lead . . .	17	4	8.8
Gum arabic . . .	4	4	4

An important improvement in the manufacture of chemical matches is the reduction of the proportion of phosphorus to a minimum. This is effected by reducing the phosphorus to an infinitesimally minute division, by which the manufacture is rendered more economical, and the matches, when ignited, have less of the unpleasant odour of phosphorus. This division is accomplished by using a solution of phosphorus in bisulphuret of carbon, by which a saving of $\frac{1}{20}$ ths of the phosphorus is obtained. Another invention is that of Messrs. Puscher and Reinsch, who have proposed the employment of sulphide of phosphorus.

Ivory.—The lecturer, having given some details respecting the properties of ivory, said: I will now call your attention to the substitution of the following mixture for ivory tablets as applied in photography. Finely-pulverised sulphate of baryta is mixed with gelatine or albumen, compressed into sheets, dried, and polished; these sheets are ready for use in the same way as ivory plates. You are all doubtless aware that the nut of the *Phytolapha macrocarpa*, of the palm tree tribe, has for many years been used in this country as a substitute for ivory, and it may be interesting to you to be made acquainted with the two following facts, viz., that the nut is composed of—

Pure cellulose . . .	81 per cent.
Gum . . .	6 „
Nitrogenated principles . . .	4 „
Water . . .	9 „
Total . . .	100

and Dr. Phipson has recently published a method of distinguishing this vegetable ivory from the animal one by means of sulphuric acid, which gives a beautiful purple colour with the vegetable ivory, but none with the animal ivory.

Horn.—The best quality of horns, and especially the beautiful ones obtained from the buffaloes in India and America, receive a great variety of application at the present day, owing to their great toughness and elasticity, as well as to their remarkable property of softening under heat, of welding, and of being moulded into various forms under pressure. To apply horns to manufacture they are treated as follows:—They are first thrown into water, and slight putrefaction commences, by which ammonia is produced, when the horn begins to soften. To carry this action further the horns are transferred into a slightly acid bath, composed of nitric and acetic acids, with a small quantity of various salts. When the horns are sufficiently softened, which requires about two weeks, they are cleaned and split into two parts by means of a circular saw, and these are introduced between heated plates, and the whole

subjected to an intense pressure of several tons to the square inch. The plates may be moulds, and thus the horn may be compressed into any required shape. A great improvement has recently been effected in this branch of manufacture, which consists in dyeing the horn various colours. To accomplish this the horn is first dipped into a bath containing a weak solution of salts of lead or mercury, and then rubbing upon the horns impregnated with metallic salts, a solution of hydrosulphate of ammonia, when a black or brown dye is produced. Another method consists in mordanting the horn with a salt of iron, and dipping it in a solution of logwood. Of late very beautiful white fancy articles have been produced from horn by dipping it first in a salt of lead and then into hydrochloric acid, when white chloride of lead is fixed in the interstices of the horn, which then simply requires polishing.

This lecture, as well as those which followed, were illustrated by numerous specimens and experiments.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. PERCY, F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.

LECTURE XI.—Thursday, January 28.

LADIES AND GENTLEMEN,—We will proceed this morning with the subject of coal. I endeavoured on the last occasion to explain that all varieties of coal, including peat and lignite, might easily be deduced chemically from woody tissue by the elimination of marsh gas, carburetted hydrogen, carbonic acid, and water. This might be rendered clear to demonstration by bringing before you a number of formulæ, but I trust you will take my word for the result, as a lecture of this kind is hardly the occasion for the discussion of such formulæ.

Nitrogen is also found in coal. I know no exception at present. It generally exists to the extent of about 1 or 2 per cent. Sulphur, likewise, is always there, and it exists in several distinct states—as iron pyrites—bisulphide of iron, sometimes finely diffused through the coal so as scarcely to be visible, and at other times existing in thin laminæ or small particles, or in nodules, and occasionally even as beds of one or two inches in thickness, or more than that. It is there as sulphate, the sulphur being in the form of sulphuric acid combined with bases,—as sulphate of lime, for example. It is also present in a state of organic combination, just as we find sulphur existing in fibrin or albumen on various azotised organic tissues. This, I think, has been proved to demonstration by analysis. We have examined coals, and determined the proportion of iron contained in the ash, and also the absolute amount of sulphur in the coal, and we find that occasionally there is much more sulphur than can be accounted for by the iron pyrites present. Further, we find that it cannot be explained in such cases by the existence of sulphates. It must, therefore, exist in a state of organic combination.

All coal contains a certain amount of inorganic matter or ash, derived partly from the mineral constituents of the plants from which the coal has been generated, and also in part from earthy matters which have been washed in during the time of the formation of the coal. Accordingly, if we examine the composition of the ash of coal and that of the bed and roof of a coal-pit, we shall find that the ash has in many cases almost identically the same composition as the matters forming the bed and the roof. This has been very clearly shown by Mr. Taylor, who has given us several excellent analyses illustrative of the fact.

The iron pyrites in coal is subject to spontaneous decomposition. It is oxydised by the action of moist air, and becomes converted into what is called misy—a yellow basic sulphate of sesquioxide of iron. If we open an old colliery,

for example, we find little patches of these substances here and there. The combustion of iron pyrites generates much heat, and occasionally causes the spontaneous ignition of the coal—an accident occasionally attended with great loss, especially in the South Staffordshire district. I might here take occasion to observe that I am disposed to believe that there is another cause of spontaneous ignition similar to that which determines the spontaneous combustion of cotton waste—namely, the absorption of oxygen by coal reduced to a fine state of division. M. Marsilly, who has charge of a railway department in the north of France, has made some curious observations upon coal with reference to the presence of marsh gas in it. Certain coal—in fact, coal generally—when exposed to a gentle heat, or even *in vacuo*, evolved inflammable gaseous matter, and also a little liquid matter—I will not say resinous, but reminding one of the odour of benzine, too small to be investigated at present. He says also that only certain coals evolved this combustible gaseous matter, and he has met with coal, from which only carbonic acid and nitrogen could be obtained. “Therefore,” he says, “by the examination simply of a piece of coal in this way, I can at once state whether fire-damp will be found in a colliery or not.” This accords, to a certain extent, with our experience. We know that there are certain coal-fields which are apparently free from fire-damp; but at present we are unable to explain the cause of the absence of carburetted hydrogen. There must, of course, be some local peculiarity to account for it; but, as far as I know, this point has not yet been the subject of investigation. The explosions which we hear of from time to time in ships laden with coal are due to the gradual escape of the carburetted hydrogen contained in the coal, its admixture with atmospheric air, and its subsequent ignition.

With regard to the varieties of coal much might be said. I shall, however, content myself with very few remarks upon the subject. We have, first of all, the lignites—a very extensive series—which are not classed ordinarily by geologists as coal proper, inasmuch as they do not belong to the carboniferous series; but in many respects they very closely resemble coals, and chemically they certainly are coals, and some, if I mistake not, are identical in composition with coals from the true coal measures. These lignites vary much in external character—some, we find, presenting the appearance of wood, and others being so coal-like that we cannot distinguish from true coal. Occasionally they are, more or less, schistose and earthy. Their colour varies from brown to deep black. They are all, more or less, brittle. Some of them are remarkable as containing a large amount of iron pyrites, which causes them speedily to weather, and various very offensive products are driven off by the distillation on burning of such lignites. You remember I pointed out one peculiarity which, I think, is deserving of your attention—namely, that lignites generally contain a large amount of water; and so far they approximate in character to wood. This is a point which has not been sufficiently dwelt upon, I think, by geologists. We have found sometimes 15, 18, or 20 per cent. of hygroscopic water. The lignite to the eye and to the touch will appear perfectly dry like a piece of dry wood; but yet on the application of a gentle heat all this water may be expelled, as in the case of wood. This water not being water displaced from combination may be reabsorbed by the exposure of the lignite to the air. I may mention to you the occurrence of magnificent lignites in Trinidad, about which a monograph has been written, together with a statement concerning their geology, by Mr. Wall, a gentleman formerly a student of this Institution. They are very remarkable lignites. The mineral pitch which has been produced there has been derived from those deposits by the application of heat.

We have several distinct varieties of coal occurring in this country.

First comes the large class of bituminous coals, which

burn with a smoky flame. The term “bituminous” has been used in a very indefinite sense, for such coals contain no bitumen properly so-called—that which mineralogists designate bitumen. The term bitumen has been used by some persons to designate the volatile constituents of coal, or those constituents which are expelled when the coal is exposed to a red heat in a close vessel. These bituminous coals may be divided into two very distinct classes, with regard to their mode of burning. First, we have those which are non-caking; secondly, those which are caking. By “non-caking” I mean coals which, when heated, do not soften and consolidate so as to form a solid coke. By “caking,” I mean those coals which, by heating, become converted into a solid coke. They seem to soften and agglutinate. The coals which we burn in London, and which are obtained from the North of England, are caking coals properly so-called. The non-caking coals we find in Staffordshire and other parts of England. With regard to their constitution, they may be divided into two very distinct groups—namely, those which are rich in oxygen, such as South Staffordshire coals, containing about 15 per cent. of that substance, and those which are poor in oxygen. The latter are typified by certain coals in South Wales. These form two very distinct classes. We have, as the final term of the series, “anthracite,” which occurs abundantly in South Wales and in the United States of America. This anthracite may be practically regarded as pure carbon. I use the word “practically.” It contains a very large amount of carbon, but there is always present some hydrogen, some oxygen, and some nitrogen. Even in the best and most characteristic anthracite I have found as much as about one per cent. of nitrogen; but in a practical sense anthracite may be regarded as carbon, and it is the final term of the series. These coals are shining black, breaking with a conchoidal fracture, not staining the fingers when touched as ordinary bituminous coals do. Some anthracites decrepitate remarkably when heated, however carefully. We have had specimens of this kind from the Vale of Neath, which, when heated even gradually to redness, become reduced to an almost impalpable dust. This is a source of great inconvenience in the application of such coals—to the smelting of iron, for example. In fact, it is one of the chief reasons why anthracite has not been used successfully in this country for that purpose. It has been used, we all know, but not successfully in the proper sense of the term “success,” owing to this curious decrepitation—this splitting into minute fragments, which accumulate to such an extent in blast furnaces after a time as to seriously impede the operation of the blast, preventing its passage through the mass. In the United States, on the other hand, I believe anthracite occurs which does not decrepitate to the extent of our own anthracite, and it is extensively and successfully used for the purpose of smelting.

While referring to anthracite, I may mention the semi-anthracitic varieties of coal of which the South Wales people speak, which are a close approximation to anthracite, and are well adapted for steam navigation. Only a short time ago we had an opportunity of examining some steam coal from China, sent by the Admiralty, and amongst them was a magnificent steam coal, equal to any occurring in South Wales.

In coals we find occasionally certain foreign matters. Among these I may mention the beautiful resinous substances which we have found. I have placed specimens before you of all these. I have had occasion to examine a good many during the last few years. Here, for example, is a beautiful mass of resin from a lignite or coal found in Tasmania. It might be mistaken for common copal. Amber occurs extensively in some lignites—as in those from Greenland, for example. These substances are the resinous exudation in former times of the trees and plants from which the coal has been derived.

With regard to foreign matters in coal, I have already mentioned the presence of lead, occurring, as galena, sometimes in distinct nodular masses. Arsenic also has been found in coal. Daubrée in the examination of certain lignites has met with distinct traces of arsenic. He also informs us that he has found both arsenic and antimony in the coal of Newcastle-on-Tyne, and occasionally copper and antimony. We have found distinct traces of arsenic in a coal from Nottinghamshire. The anthracite of South Wales which we have been using here for many years is generally impregnated with distinct traces of copper. This is a subject of inquiry which has not been yet very extensively investigated.

In concluding this subject of mineral fuel, I might mention Fremy's researches on combustible minerals. He has attempted to determine the age of coal by certain chemical actions. Thus he says with respect to lignite that the varieties known as bituminous wood are, like peat, soluble in alkalis, but they dissolve almost completely in nitric acid and the hypochlorites. Compact and black varieties resembling bituminous coal are, in general, not acted upon by alkalis, but dissolve completely in hypochlorites and in nitric acid. Bituminous coals, he says, do not dissolve in alkaline solutions, or in hypochlorites; but bituminous coals and anthracite dissolve completely in a mixture of monohydrated sulphuric acid and nitric acid. It is entirely thrown down by the addition of water. I made some experiments upon this subject with reference to Fremy's researches, but not to a sufficient extent to justify any very positive conclusion on the subject. I am not, however, disposed to attach very much weight to them.

I will call your attention to one experiment concerning the artificial production of a substance very much like anthracite by Daubrée. He heated fragments of fir in a close tube along with water, at a high temperature, and, therefore, under great pressure, when it was transformed, he says, into a black mass having a bright lustre, perfectly compact, and, in fact, resembling pure anthracite; it was so hard that a steel point scratched it with difficulty. This is a curious experiment, and one well worthy of note. We find in our coal pits, occasionally, the intrusion of a most unwelcome visitor in the form of trap, a rock of igneous origin. The coal in the vicinity is more or less coked. It does not present the least appearance of anthracite, nor do I suppose it possible that anthracite could have been produced simply by the operation of heat in this way, by a coking operation. There is also another reason which would render this view extremely difficult to explain. If anthracite were nothing but bituminous coal deprived of the certain proportion of its volatile matter so called, by the application of heat, then we ought to find a considerable proportion of ash in such coal, which is not the fact. We occasionally meet with anthracites containing a very small proportion of ash. There must, therefore, be some other condition to explain the circumstance, and that condition will probably be found in the action of water at a high temperature. That, however, is a mere speculation at present.

We now arrive at the subject of fossilisation—one of considerable interest. Fossilisation is the perpetuation, or the conversion—(I will take that word in preference)—of the frames of plants and animals into stone-like substances, whereby their forms are retained, sometimes with remarkable perfection. It is requisite to distinguish carefully between fossilisation and incrustation. Incrustation is a process we very often see, as, for example, at Matlock Bath, where a spring water occurs richly impregnated with bicarbonate of lime. That water, on exposure to the air, loses a portion of its carbonic acid. The carbonate of lime, consequently, becomes insoluble, and is thrown down in the form of a deposit. The same process takes place with waters at Carlsbad. You may see specimens of the result in the museum above. That, however, is not

fossilisation. This deposition is sometimes called incrustation, but is more frequently spoken of erroneously as "petrification." One frequent incrusting matter is carbonate of lime. Silica is another; and at St. Michael's, in the Azores, there is a stream containing so much silica that plants in it are said to have their tissues replaced entirely by silica. Carbonate of protoxide of iron, gypsum, brown iron ore, iron pyrites, and carbonate of zinc are also found occasionally acting as incrusting matters. There is one specimen in the case in the museum above well deserving of attention, where incrustation has occurred by the percolation of water containing carbonate of zinc.

We have a filling of the casts of fossils with various matters. Sometimes they are filled with the same stuff as that in which they occur, for example, sandstone with sandstone. Sometimes they are filled with another kind of matter, as in the echinus in the chalk, the interior of which becomes filled with flint, while the shell is changed into calc spar. Yet this has occurred in the chalk itself.

Fossilisation takes place by various agents. There is fossilisation by carbonate of lime in the form of calc spar, or as fibrous or compact carbonate of lime. In shells of living animals the carbonate of lime is either amorphous or in the state of arragonite. In the crinoids the stems break with a curious rhombic fracture, and each joint seems to represent, as it were, a distinct crystal, and the internal alimentary canal is always the main axis of the crystal. If we break a series of joints in the same animal in succession, we find that every joint is slightly turned at a certain angle, but we do not find that the cleavage planes are parallel. If all the joints were cleaved a spiral series of cleavage planes would be presented. The same is true of echinus spines when similarly converted into calcspar. That is a very curious point.

Fossilisation occurs with silica as in the case of wood. Here is a specimen of an endogenous tree partially silicified. The wood has been removed, and replaced by particles of silica. Every trace of the structure is distinctly visible under the microscope. It is one of the common forms of silicification. When shells imperfectly silicified are acted upon by an acid the outer part resists, for it is this which consists mainly of silica, but the interior dissolves. Thus silicification takes place always from the exterior inwards.

Iron pyrites partially or wholly replaces organic remains. We find magnificent specimens of this in the ammonites, of which several are placed before you. In bivalve shells we do not meet with this replacement, and there seems to be a good reason for it. The iron pyrites appears to be generated by the action of the decomposing organic matter upon sulphates in solution in water. Of course there must also be iron present at the same time. In the case of bivalve shells this matter speedily escapes and flows away or is otherwise removed, and therefore we do not find replacement by pyrites.

Replacement also takes place by means of hydrated sesquioxide of iron, pseudo-morphous after iron pyrites. I think I mentioned this on a former occasion. Iron pyrites is not unfrequently found converted into hydrated sesquioxide of iron by weathering action under certain specific conditions. It is formed also by deposition from springs, for when spring water which contains carbonate of iron—(protoxide of iron dissolved by the aid of carbonic acid)—is exposed to the action of the air, the iron becomes peroxidised, being converted into sesquioxide of iron, and in that state it no longer contains carbonic acid, which escapes, and we have a deposit of hydrated sesquioxide of iron. This is the way in which fossilisation may occur from this mineral.

It occurs also from red iron ore, and even from specular iron ore, as well as from sparry iron ore.

Gypsum is occasionally found replacing shells, which have been completely changed into it. This occurs in the

stratum of fossiliferous gypsum in the Keuper formation in Würtemberg. There are also gypsum casts of shells in Montmartre, near Paris.

Here I may take occasion, ladies and gentlemen, to express my regret that this institution, which, above all others, ought to have a fine collection of specimens illustrative of fossilisation, has but very few of the kind. I do hope that before long we shall have a suitable collection to illustrate the phenomenon of replacement by these various substances. It is one of extreme interest and importance in its geological relations.

I may place before you a very pretty series of specimens presented to the institution by Mr. Sorby. They illustrate the various modes of pseudo-morphism. We have the fact of such changes clearly established. The more or less complete conversion of the mass into the superficial substance is entirely a matter of time.

Vivianite, or the blue phosphate of iron, is met with in shells occurring in the Black Sea. It is found also in New Jersey, where belemnites and bivalves are found almost, if not completely, transformed into vivianite.

Fluor spar is also met with as an agent in fossilisation. Encrinital stems in the carboniferous limestone of Derbyshire are met with converted into fluor spar.

Fossils of sulphate of beryta occasionally occur, for instance, in the lias in France, and in ammonites at Whitby. They occur also in the tertiary at Kreuznach, in Prussia. I have seen sulphate of baryta several times in iron ore in South Staffordshire. The cracks have been filled with a white matter, which has been found to be that substance.

Sulphate of strontia is another substance, forming fossils. Fossils of this substance have been found in the Tyrol and in France.

Sulphate of lead has been found in fossils at Semur in France, and elsewhere.

Carbonate of lead is also found as a fossilising agent. It occurs in crinoids in limestone in Poland, traversed by a vein of galena.

Fossilisation takes place by blende, and also by carbonate of zinc. It occurs with vitreous copper—that is, the sulphide of copper in the case of certain seeds in Hessen. By copper pyrites, it occurs in various localities. It takes place with cinnabar in the case of some fish remains at Münsterappel, Bavaria, and with talc and pyrophyllite. Glauconite, or green silicate of copper, is another agent in fossilisation, as in the case of certain infusorial fossils. Fossilisation occurs also by means of the mineral pinguite; and it occurs even by sulphur in a fresh-water formation in Arragon, with the remains of planorbis and char. It takes place also by means of anthracitic carbon in the interior of cephalopods at Kertch.

We may dismiss this subject of fossilisation, which is one of great interest in many respects.

(To be continued.)

ACADEMY OF SCIENCES.

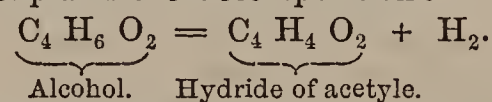
June 27.

A LETTER from MM. Wöhler and G. Rose stated that they had been making experiments on the Colouring Matter of the Emerald. Lewy, in 1858, asserted that this colouring matter was organic, and was destroyed by heat—a result which the authors of this letter could not confirm. They kept an emerald at the temperature of melted copper for an hour, and found that, although the stone became opaque, the colour was not affected. They fused, however, some colourless glass with an exceedingly small quantity of oxide of chromium, and produced a colour exactly like that of the emerald. They therefore considered this substance the colouring agent, without, however, denying the presence of some organic matter.

MM. J. and Jules Persoz contributed some "Observations on the Nature of Tungsten," a metal generally considered of an anomalous character. The authors sent a sealed paper,

and all they tell us now is that they are in a position to announce the existence of several distinct radicals in tungsten, which give rise to various acids, one of which is perfectly white, and contains very different proportions of oxygen. One of these elements forms two compounds with oxygen, both having well-characterised basic properties, and furnishing salts,—the lower oxide, colourless salts, and the higher oxide, salts of a yellow colour, like that of chloride of gold. The processes by which they have separated the radicals and obtained the salts are detailed in the sealed paper, the opening of which we shall await with much curiosity.

M. Jaillard contributed a paper "On the Electrolysis of Vinic Alcohol." The author made the alcohol conduct by adding to 100 parts one part of SO_3HO , and one part of KOH . The liquid was then electrolysed by ten large Bunsen's cells. Hydrogen was obtained at the negative pole, while the positive seemed inactive. But the liquid acquired a smell very much like that of aldehyde, and on submitting it to distillation the author collected a small quantity of fluid which he recognised as the body named by Gerhardt *hydride of acetylene*. The following equation, he believes, explains the decomposition:—



M. Cahours presented a note "On the Respiration of Flowers." This was an interesting paper, in which the author shows that while the green parts of plants under the influence of light absorb carbonic acid, assimilate the carbon, and give out oxygen, the coloured parts, on the contrary, under the same circumstances, absorb oxygen, and give out carbonic acid. The amount of carbonic acid evolved seemed to increase as the temperature rose; and a growing flower gave out more than a fully blown one.

A note by M. Debray, "On the Dimorphism of Antimonic and Arsenious Acids," gives an account of methods by which both these acids may be obtained either as regular octohedra or rhomboidal prisms. These two latter papers deserve reproduction.

NOTICES OF BOOKS.

Memoirs of Distinguished Men of Science of Great Britain Living in the Years 1807-8, and Appendix. With an Introduction by ROBERT HUNT, F.R.S., &c. Compiled and arranged by WILLIAM WALKER, junior. Second Edition. London: E. and F. N. Spon. 1864.

THIS is a series of very short and rather dry biographies, introduced by a little fine writing by Mr. Robert Hunt. The book we notice is intended as a companion to the engraving by Mr. Walker, senior. Apart from this, however, it possesses some value as offering, in a small space, a careful and accurate record of the men who made the commencement of the present century a marked epoch in the history of the progress of science.

NOTICES OF PATENTS.

Communicated by MR. VAUGHAN, PATENT AGENT, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

563. Thomas Gray, Mitcham, Surrey, "Improvements in the treatment of 'jute' and 'jute' cuttings."—Petition recorded March 5, 1864.

819. Stephen William Silver, Bishopsgate-street, London, "Certain machinery for extracting the juice of the *sapota mulieri*, or bullet tree."—A communication from John Thomborrow Manifold, Demerara, British Guiana.—Petition recorded April 2, 1864.

1443. Charles Hill Snell, Bow-common, Middlesex, "Improvements in the manufacture of soaps and saponaceous compounds."—Petition recorded June 10, 1864.

1484. John Anthony Pols, St. Martin Street, Leicester Square, Middlesex, "Improvements in obtaining purified or refined oils, and in obtaining oil cakes and foots useful for soap making."—Petition recorded June 15, 1864.

Invention Protected for Six Months by the Deposit of a Complete Specification.

2564. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "Improvements in apparatus for smelting and reducing ores and metals."—A communication from Loomis George Marshall, Philadelphia, Pennsylvania, U.S.A.

Notices to Proceed.

406. Edward Moore, Tewkesbury, Gloucestershire, "Improvements in the manufacture of Surgical bandages."

408. Henry Newmame, Hortulan Villa, Shrewsbury, Shropshire, "A new medicinal compound pill for diseases of the liver."—Petitions recorded February 17, 1864.

419. John Travis, Luzley Brook, Royton, Lancashire, "An improved method of preventing and curing corrosion, and preserving the metal in steam boilers, steam generators, and fuel economisers."—Petition recorded February 18, 1864.

454. Eugène Alphonse Cotellet, Boulevard St. Martin, Paris, France, "An apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general."—Petition recorded February 23, 1864.

470. Thomas Rowatt the younger, and Alexander Lightbody, Edinburgh, N.B., "Improvements in lamps for burning paraffin, belmontine, petroleum, and other like hydrocarbon fluids."

474. Henry Carter, Camberwell New Road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dyeing and printing."—Petitions recorded February 26, 1864.

490. Frederick Ransome, Ipswich, Suffolk, "Improvements in the manufacture of artificial stone."—Petition recorded February 27, 1864.

552. Alexandre Manbré, Baker Street, Portman Square, "Improvements in the manufacture of glucose sugar."—Petition recorded March 4, 1864.

568. William Edward Newton, Chancery Lane, Middlesex, "Improvements in refining sugar and molasses."—A communication from L. P. R. De Massy and L. R. De Massy, Rue St. Sebastien, Paris, France.—Petition recorded March 7, 1864.

580. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture or production of baryta and strontia."—A communication from L. P. R. De Massy and L. R. De Massy, Rue St. Sebastien, Paris, France.—Petition recorded March 8, 1864.

1128. John Thompson, Hilldrop Crescent, Camden Road, Middlesex, "Improvements in apparatus for securing stoppers in bottles."—Petition recorded May 4, 1864.

1426. Ferdinand Henry Warlich, Maze Hill, Greenwich, Kent, "Improvements in the manufacture of artificial block fuel and coke, and in apparatus employed therein."—Petition recorded June 8, 1864.

CORRESPONDENCE.

Continental Science.

Paris, July 6th, 1864.

IN arranging certain specimens in the Mineralogical Museum of Zurich, Professor Kenngott discovered a piece of iron marked "native iron from Styria." Suspecting it to be meteoric, he sent it to the Director of the Imperial Museum at Vienna, who had it cut and polished. Subsequent treatment with acids left no doubt of its cosmical origin. It also contains crystals, which appear to be olivine and pyrosene, and its general character seems to identify it with the meteorite which fell many years since at Steinbach, in Saxony. It may be mentioned that no

meteorite has yet been known to have fallen in Styria. It would be interesting if the directors of museums would submit any specimens of so-called native iron that they may have in their possession to similar tests.

The hippophagists of Paris, headed by Baron Larrey and Geoffrey de St. Hilaire, have long desired to establish in this city butchers' shops where their favourite meat might be sold, but certain obstacles have hitherto prevented it. There are hopes, however, now that not only shall we have a horse butcher's shop in full operation, but also a horse restaurant. How much better you manage these things in England, where, for a few pence, you can obtain, both raw and cooked, sufficient horseflesh to satisfy the most inveterate horse-eater. By the way, what would be the proper English word for horse-meat? According to the rule enunciated by the famous Saxon etymologist, Wamba, it should be *cheval*, or some word derived from it. However, joking apart, I can personally testify that young horse is quite as succulent as young bull, and that old horse is infinitely more palatable and tender than old cow.

The French Society for the Prevention of Cruelty to Animals (*Société Protection des Animaux*) goes further than the English institution by not only endeavouring to prevent its *protégés* from being cruelly treated, but by rewarding inventions tending to increase their comfort and well-being. At the last meeting of the Paris society, medals were given for a new form of horse-shoe for use in slippery weather, a saddle which is stated to be more comfortable than the ordinary form, a horse-collar having similar merits, a sieve for cleaning grain from dust and grit, trusses for the cure of hernia in young horses, and an apparatus for the more effectual aeration of the water in fish tanks during transport.

In a letter to M. A. Quetelet, of Brussels, M. Heidinger, of Vienna, who has so thoroughly identified himself with the investigation of meteorites, gives some interesting particulars of the fall of an aerolite at Inly, near Trebizond. It fell in an easterly direction at about three o'clock in the morning on December 10 last, with a terrific explosion, resembling the discharge of hundreds of cannon. Some pieces supposed to belong to it have been forwarded to Vienna, but from the examination already made of them their origin seems to be rather terrestrial than cosmical.

M. Goldschmidt still continues his laborious investigations into the singular variability of the star 40,196 (*Lalande*). The result of his observations is that it accomplishes its wonderful cycle in a period of 197 days. It remains nearly invisible for 61 days, it then gradually increases in luminosity for 56 days more, remains stationary for a perceptible period, then diminishes for 78 days, and finally disappears.

Father Secchi, of Rome, so well known to your readers by his lunar observations and drawings, has just published a work called "*L'unità delle forze fisiche*," which, from a cursory glance, promises to be most exhaustive in its character.

Some of my friends here who belong to the fourth estate are full of a new instrument, lately invented by M. Bryois. It is called a "*Sténographe imprimeur mécanique*," and is for the purpose of taking short-hand notes with increased quickness. It consists of a series of levers worked by keys like a piano, and acting on a series of types which impress themselves on a strip of paper which gradually unrolls itself. Working only with one finger, an ordinary operator can work as quickly as the best short-hand reporter, but by using two hands the celerity is increased to a surprising degree. Imagine it being stringed and introduced into the gallery of the House of Commons, what brilliant fantasias would be performed when certain members were on their legs—what dreary tunes would be given out when other members were on theirs.

A distinguished member of the London Chemical Society has just informed me that a sub-committee has

been formed from amongst the members of the council of that body to decide on the question of doubling certain of the equivalents in accordance with the views of Cannizzaro, Würtz, Williamson, and others. Although, of course, the truth or falsity of a theory cannot be settled by act of Parliament, still, the authoritative declaration of the representatives of a learned body would do much to settle the matter and produce that unity of formulæ so much desired by your Hanwell correspondent in his letter in last week's CHEMICAL NEWS.

I see that the Cornish fellow-townsmen of Sir Humphrey Davy are about to erect a monument to his memory in the form of a very ugly obelisk. Would not a scholarship or even a medal to be given annually in connection with the College of Chemistry in the Chemical Society be a more fitting way of expressing our admiration of this great man? I am sure if such an idea were started it would receive the most earnest support from every foreign *savant*, who, although they quarrel amongst themselves on every subject, agree at least upon one—the greatness of our greatest English philosopher.

Properties of Silicates.—New Antidotes.

To the Editor of the CHEMICAL NEWS.

SIR,—Gelatinous silica being known to be soluble in alkaline solutions such as those of caustic soda, it might fairly be presumed that it would also be soluble in an alkaline silicate, although I am not aware of this having been published as a fact.

But the same property could not probably have been anticipated of the silicates of the earths and metals. The silicate of magnesia, for example, in the gelatinous or recently prepared state, is not soluble in a solution of caustic soda, but readily so in a solution of silicate of soda; and the latter rule holds good through all the series of silicates.

The solvent power of the alkaline silicates seems, therefore, to be altogether different in degree and in other important particulars from that of other alkaline solutions. Hence through this property we have soluble glass in as great variety and of tints as various and delicate as we have in stained glass. The soda silicate of cobalt is of a beautiful rose colour—that of chromium green, &c. But the tints of the metallic-coloured silicates are modified by solution in the colourless compound soluble silicates—that of copper, for instance, in a soda silicate of magnesia, is different from that of its solution in silicate of soda.

The above facts will, I think, be sufficient to indicate the importance of a true knowledge of the compound soluble silicates in geology and mineralogy, and lead to a more exact explanation of the colour of a great number of minerals and of many of the precious stones.

The silicic acid of the alkaline silicates again displaces the carbonic acid in carbonates, even at the ordinary temperature, and very rapidly by the aid of heat. This fact will aid towards explaining the formation and composition of many rocks, and be a guide in the production of artificial stones in endless varieties.

As regards agriculture, the ammonio-silicates seem not only to be the most soluble, but also to possess the greatest solvent powers of all the alkaline silicates. When we add to the series the phospho-silicates, also highly soluble, it seems to me that a field of investigation is laid open worthy of the highest science of the day in the department of agricultural chemistry, and which, if followed, is likely to lead to practical results of vast importance, and to a true solution of many things that have not hitherto been satisfactorily explained.

There is still another field open to investigation with these interesting compounds, namely, the use of them as antidotes to poisons.

For this purpose I would suggest the soda silicates of magnesia, alumina, and lime. In case of any poisonous

mineral salt being taken, an instantaneous precipitation of an insoluble silicate would occur in the stomach, and probably without the least injurious effect to the coats thereof, by prompt administration of a dilute solution of any of the above-named compound soluble silicates, or of a solution of silicate of soda saturated with gelatinous silica. It is a question which I have commenced investigating, whether the alkaloids may not be rendered insoluble, and therefore inert, through their means.

I am, &c.,

HENRY ELLIS.

Bangor, June 28.

The Chemical Society.

To the Editor of the CHEMICAL NEWS.

SIR,—In your notice in the last number of the CHEMICAL NEWS of my remarks at a recent meeting of the Chemical Society there is a trifling error. It would appear from the report that I had alluded to nitro-compounds of the hydrides or radicles, when, in fact, my process of separation was founded on their power of resisting fuming nitric acid.

I said that this question of isomerism was attended with the greatest possible difficulties, so much so that it behoved us in the present instance to suspend our judgment.

I also said that among the product of the distillation of Boghead coal were several hydrocarbons, having the composition and vapour densities of the alcoholic radicles, the substance having the composition of butyl, differing, however, from Kolbe's butyl in having a boiling point eleven degrees higher. Like the radicles, the hydrocarbons in question were almost entirely unacted on by fuming nitric acid.

I also called attention to the fact that in my original memoir I had stated that they might be the isomeric hydrides, but that I was unable to find any decided differences between them and the radicles.

I also further stated that I had since found that the lutidine from cinchonine was certainly distinct from the lutidine of bone oil. I did not say anything about the lutidine from Boghead coal. I do not think it has, as yet, been obtained from that substance.

Trusting to your kindness to make the above corrections,

I am, &c.

C. G. WILLIAMS.

Harrow, July 4.

[We regret that the observations of our esteemed correspondent were delivered in a tone so inaudible that the reference to the origin of the two distinct kinds of lutidine was but imperfectly apprehended. The second paragraph above is practically synonymous with the statement of our reporter, and the opinion of the hydrides being not merely isomeric, but absolutely identical, with the organic radicals was, of course, the main point both of the lecturer's and of our correspondent's remarks.—ED. C. N.]

ANSWERS TO CORRESPONDENTS.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

A Reader.—See page 61 of our last volume.

J. W. M. will see his question answered in another part.

M. P. S.—Under consideration.

G. B.—The exact form of the apparatus is of no consequence: what you describe will answer very well.

A Reader.—We cannot give surgical advice, but we may answer your first question in the negative. With regard to the second, an operation is sometimes performed for the purpose which is occasionally successful. Apply to a respectable surgeon.

SCIENTIFIC AND ANALYTICAL
CHEMISTRY.

On the Motions of Benzoic Acid on the Surface of Water,
by CHARLES TOMLINSON, F.C.S.

IN a shilling volume published in Weale's Rudimentary Series* I have traced the history of that remarkable fact—the motions of camphor on water,—which has also been discussed in the pages of the CHEMICAL NEWS.† In getting up the history I was so fortunate as to discover a letter written in Latin by the celebrated Volta to his friend Dr. Frank, ‡ which seems to have escaped the notice of subsequent writers, and its very existence was denied by Dutrochet, who, writing on the subject of the camphor motions, remarks that “*Volta n'a rien écrit lui-même sur ce sujet.*” §

Referring to the motions of camphor, Volta says:—“I had scarcely made up my mind as to the nature of the phenomena when I was bold enough to predict to you and Brugnatelli that flowers of benzoin, having about the same volatility as camphor, would display similar effects. When this opinion was tested by experiment, I saw, not without pleasure, the glittering, feathery little crystals of benzoin, when thrown on the surface of water, divide, repel each other, and rotate even more perfectly than fragments of camphor. Indeed, this rushing to and fro and the rotatory motion are more striking than in the case of camphor, although the phenomena do not last nearly so long.”

I have often repeated this experiment, which requires the same precautions as to chemical purity as in the case of camphor, and also a certain elevation of temperature. Where the experiment fails in cold or damp weather on clean water at the temperature of the air, it will succeed with water raised to 80° or 90°. In dry, warm weather this experiment may be easily performed. Of course, the sublimate itself must be clean; if, while being purchased, it is put into or taken from the scale pan with the fingers by the gentleman who serves it, that slight source of impurity may endanger the result.

But my object in writing this note is to point out a new method of performing the experiment. If a few drops of oil of bitter almonds be exposed to the air in a watch-glass they will, in the course of some hours, solidify into thin crystalline flakes of benzoic acid. One or two of these flakes placed on the surface of clean water in a clean glass will rotate with great vigour, throwing off a visible film, the reaction of which produces the motion. In a shallow glass vessel four inches in diameter the motions last longer than in a vessel of smaller diameter, but when the adhesion of the surface is satisfied by being completely covered with a very thin film, the motions can be renewed by removing the flake of benzoic acid to a clean vessel of water. The flake should be removed on the end of a clean platinum spatula, or some similar tool, and on touching the surface of fresh water with this the fragment will dart off from it and commence a new series of wild gyrations and wide sweeps on the surface, often vibrating rapidly up and down the capillary curve of the water, as if seeking to leap out of the vessel. It will then move rapidly round the circumference, as if seeking an opening by which to escape, and all at once will suddenly stop, throw off one

or two small fragments which spin wildly, and disappear, and then renew its eccentric wanderings until the adhesion of the surface is again satisfied. If the fragment be now transferred to another vessel it will resume its antics as before.

Although in these motions there is much that is common to camphor, there is also something belonging to benzoic acid, such as a series of agitated, trembling, zig-zag motions, and rapid rotations as if upon a fixed vertical axis. The crystalline flakes are very favourable to this last result, since by lying flat upon the water there is a more perfect adhesion. When the flake has a little of the oil of bitter almonds adhering to it the effect of the spinning motion is very pretty; the oil forms iridescent films, which, by the rapid rotation, are thrown into circles, giving the effect of a brilliant firework on the surface of water.

In the CHEMICAL NEWS, No. 197, I pointed out what I believe to be the true action of oils in arresting the motions of camphor. A fixed oil stops the motions by occupying the surface with a film and preventing adhesion between the camphor and the water; a volatile oil may stop the motion only while it is evaporating, unless it leave behind a permanent resinous or other product which occupies the surface. Or it may not arrest the motions at all if the camphor film have a stronger adhesion to the water than the oil film. In this last case the camphor will sail in and about and through the oil film, as if quite indifferent to its presence. So also an oil that contains oxidised products will stop or prevent the camphor rotations; but if such oil be distilled and a drop be placed on the surface the film will have no such effect.

Now, all this applies more or less to the motions of benzoic acid on water. Oil of bitter almonds, oil of cubebs, and some others have no effect in stopping the motions of the fragments; old essential oils stop them, but if distilled do not do so; the fragments of benzoic acid will skate in and through and about the oil film, cutting it up and driving it about with vigour. Films of turpentine and paraffine oils may be mentioned as examples.

Camphor fragments rotate well on the same surface with benzoic acid. The flakes of the latter are heavier than water, and will sink if allowed to fall on the surface from some height. They remain at the bottom quite inert, but on being brought to the surface again rotate.

A few drops of oil of bitter almonds in a white glass bottle, corked, and put on the window frame will in a few hours form a deposit of benzoic acid on the side nearest the light—that is, on the coldest side.

I may mention an instance of persistence of impressions on the retina in connection with these motions. It has happened several times that on putting out the candle at night, spectra of these motions have occupied the eye for some minutes before going to sleep. The fragments of camphor, benzoin, &c., as well as the lines they describe, appear as *black* on a greyish ground; the motions are rapid, and the effect unpleasant, but entirely within the eye, not projected on a distant ground, as ocular spectra often are.

King's College, London.

PHARMACY, TOXICOLOGY, &c.

The Application of Dialysis to the Investigation of Alkaloids. New Property of Digitaline, by M. L. GRANDEAU.

GRAHAM's admirable researches on molecular diffusion

* “Experiential Essays.” Virtue, Brothers. 1863.

† Nos. 186, 188, 189, 190, 194, 197.

‡ *Delectus Opusculorum Medicorum.* Ticini, 1787. Vol. 3rd. A copy of this work is in the library of the College of Surgeons.

§ *Recherches Physiques sur la Force Epipolique.* Part I. Paris, 1842. Page 6.

have given to chemical analysis valuable processes for the separation of certain bodies. Toxicology and physiological chemistry especially will profit largely from methods of dialysis.

For some months I have followed up these researches in the medical laboratory of the College of France, and beg permission to submit to the Academy my preliminary results.

Graham has shown that by the aid of dialysis very minute quantities of certain poisons, mixed with various organic matters, may be detected, especially arsenious acid and strychnine; and I have myself already experimented on morphine, brucine, and digitaline.

1. Dialysis of Digitaline.—Place in the dialyser 100 cubic centimetres of distilled water holding in solution 0 gr. 01 of pure digitaline. Suspend the dialysis after twenty-four hours; carefully evaporate to dryness the liquid contained in the outer vase in a weighed platinum capsule. It will leave a residue weighing exactly 0 gr. 01, with a bitter taste, and presenting the characteristics of digitaline, of which more further on.

Evaporate to dryness in a weighed platinum vessel the liquid remaining in the dialyser; it volatilises, leaving no residue, all the digitaline having passed into the dialysed liquid.

2. Dialysis of Urine, containing 1 gr. 01 of Digitaline.—Into 45 cubic centimetres of fresh normal urine pour 2 cubic centimetres of a solution containing 0 gr. 50 of digitaline to 100 centimetres cube of water; after eighteen hours suspend the dialysis and evaporate to dryness the liquid in the outer vessel (about 300 cubic centimetres). Extract the almost colourless residue by alcohol; and the alcoholic solution, evaporated to dryness, shows all the characteristics of digitaline with as much clearness as the residue of two cubic centimetres of the normal solution of digitaline. Evaporate separately the contents of the dialyser, and the residue will be brown; then extract by alcohol of 95°, and the greenish solution thus obtained will give all the reactions indicating the presence of traces of digitaline. The dialysis then was not complete.

3. Dialysis of Morphine, Brucine, and Digitaline Mixed with Animal Matters.—Take the stomach and intestines of a dog (some hours after death), macerate them in water at 25° or 30° for about two hours; filter the yellowish, strongly-smelling liquid through canvas. Divide it into four parts, each of 250 cubic centimetres; to the first add 0 gr. 04 of digitaline; to the second, 0 gr. 02 of brucine; to the third, 0 gr. 02 of hydrochlorate of morphine; leave the fourth intact; dialyse these four liquids separately. After twenty-four hours carefully evaporate the liquids contained in the outer vessels; recover each of the residues by alcohol, to separate the mineral salts (salts of soda, lime, &c.) which have been dialysed. The ordinary reagents of brucine (nitric acid) and of morphine (nitric acid, perchloride of iron) clearly show the presence of these alkaloids in the residues of the alcoholic liquids. Digitaline is found equally in the water of the first vessel. Divide the residue of the evaporation of that portion of the liquid to which no vegetable alkali was added into several parts, and test it with the reagents used to discover brucine, morphine, and digitaline. This experiment is merely intended to show that the animal matters, to which the poisonous substances are added, do not by themselves give, with reagents, colorations which might lead to error. The result of this test leaves no doubt as to the value of dialysis applied to researches of this kind.

In the course of this preliminary study I endeavoured to find some reaction as much as possible characteristic of digitaline. Hitherto we know no reaction for distinguishing digitaline from other vegetable poisons, except the green colour obtained by dissolving this substance in concentrated hydrochloric acid. This reaction, as has been observed, cannot be taken as an unfailing indication of the presence of digitaline, for the same colour is produced by several other organic matters. The successive action of sulphuric acid and bromine vapours have hitherto seemed to characterise even very small quantities of digitaline. Pure digitaline takes a sienna-brown colour on contact with concentrated acid, turning after a time to vinous red, and on the addition of water immediately becoming dirty green. When, instead of operating on, for instance, 1 centigramme of solid digitaline which has not yet been in contact with any liquid, we submit to the action of sulphuric acid the residue of the evaporation of several drops of a diluted solution of digitaline, the colour, instead of brown, is lighter or darker reddish-brown, according to the quantity of material employed. With very small quantities of digitaline (0 gr. 0005, for instance), the colour is rose, like the flower of the digitalis. On exposing digitaline, moistened with sulphuric acid, to bromine vapours, the mixture instantly becomes violet, and the shade varies from heartsease violet to mauve, according as there is present more or less digitaline. The coloration shown by sulphuric acid, and modified by bromine vapours, is most distinct with the residue of the evaporation of 1 centimetre cube of water containing 0 gr. 005 of digitaline; it is also very clear with 0 gr. 0005 of this poisonous substance. It is observable with even the very faintest traces of digitaline. None of the following substances, which I have submitted to the same reaction, has evidenced this property:—Morphine, narcotine, codeine, narceine, strychnine, brucine, atropine, solanine, salicine, santonine, veratrine, phlorhizine, daturine, amygdaline, asparagine, cantharidine, caffeine.

Dialysis—and in this consists its greatest value—allows the separation of the vegetable poisons from the animal substances with which they are mixed, in a state sufficiently pure to enable us to identify them by their principal characteristics.—*Comptes Rendus*, lviii, 1048.

PHYSICAL SCIENCE.

Investigations on the Specific Heat of Solid and Liquid Bodies, by HERMANN KOPP, Ph.D.

(Continued from Vol. IX., page 295.)

THE author next discusses whether it is to be assumed that the elements enter into compounds with the atomic heats which they have in the free state. This assumption is only admissible provided it can be proved that the atomic heat of a compound depends simply on its empirical formula, and not on the chemical character or rational constitution. Much of what has previously been said favours this view of the case. It is also supported by the fact that similar chemical character in analogous compounds, and even isomorphism, do not pre-suppose equality in the atomic heats, if in one compound an atomic group (a compound radical) stands in the place of an elementary atom of another; for instance, the atomic heat of cyanogen compounds is considerably greater than those of the corresponding chlorine compounds, and those of ammonium materially greater than those of the corresponding potassium compounds. A further support for that assumption is found in the fact that, regardless of the chemical character, the atomic

heat of complex compounds is found to be the sum of the atomic heats of simpler atomic groups, the addition of which gives the formulæ of those more complex compounds. A few cases selected from the comparisons of the author may explain this. The atomic heats have been found,—

For the oxides	R Θ	11.1
For binoxide of tin	Sn Θ_2	13.8

Total for	RR Θ_3	24.9
For sesquioxide of iron	Fe Θ_3	26.8

or,		
For oxides	2R Θ = R Θ_2	22.2
For binoxide of tin	3Sn Θ_2 = R Θ_6	41.4

Total for	R Θ_8	63.6
For arseniate of lead	Pb Θ_3 As Θ_5	65.4

Finally, the author shows, as supporting that assumption, that (as was already maintained) water is contained in solid compounds with the atomic heat of ice. The various determinations of the specific heat of ice give the atomic heat of H Θ at 8.6 for temperatures distant from 0°, and at 9.1 to 9.8 at temperatures nearer 0°. The atomic heat has been found (to adduce again a few comparisons)—

For crystallised chloride of calcium	CaCl Θ + 6H Θ	75.6
For anhydrous chlorides	RCl Θ	18.5
Difference for	6H Θ	57.1
		$\frac{57.1}{6} = 9.5$

For crystallised gypsum	CaSO Θ_4 + 2H Θ	45.8
For anhydrous sulphates	RS Θ	26.1

Difference for	2H Θ	19.7
		$\frac{19.7}{2} = 9.9$

The opinion that the elements enter into compounds with the atomic heats they have in the free state has been already expressed; but the view has also been defended that the atomic heat of an element may differ in a compound from what it is in the free state, and may be different in different compounds. The author comes to the result that the latter view is not proved and is inadmissible.

As the result of all these comparisons and observations, the author arrives at the conclusion:—Each element, in the solid state and at an adequate distance from its melting-point, has one specific or atomic heat, which may indeed somewhat vary with physical conditions, different temperature, or different density, for example, but not so much as to necessitate that being taken into account in considering the relation in which the specific or the atomic heat stands to the atomic weight or composition. For each element it is to be assumed that it has essentially the same specific heat or atomic heat in the free state and in compounds. He then passes on to determine what atomic heats are to be assigned to the individual elements. As data for determining this he takes (1) the atomic heats which follow from determinations of the specific heat of the elements in the free, solid state; (2) the atomic heats obtained for an element, if, from the atomic heat of one of its compounds, which contains beside it only elements of known atomic heat, the atomic heats corresponding to the latter elements are subtracted; (3) the difference found between the atomic heats of analogous compounds of an element of unknown, and of an element of known atomic heat, in which case the difference is taken as being the difference between the atomic heats of these two elements. The author dwells upon the fact that in the indirect deduction of an element by (2) and (3) the result may be uncertain: first, because

the atomic heats of compounds are frequently not known with certainty, as is seen by the circumstance that analogous compounds, for which there is every reason to expect equal atomic heat, are found experimentally to exhibit considerable differences; but, secondly, because in such deductions the entire relative uncertainty in the atomic heats for a compound, and for that to be subtracted from its composition, is thrown upon a small number, the residue remaining in the deduction.

The details of the considerations cannot be gone into by which the author deduces the atomic heat of the individual elements; the results simply, which are not all attained with equal certainty, may be adduced. The author adopts the atomic heat 1.8 for C, 2.3 for H, 2.7 for B, 3.7 for Si, 4 for Θ , 5 for F, 5.4 for P and S, 6.4 for the other elements for which or for whose compounds the atomic heat is known in somewhat more trustworthy manner, it being left undecided in the case of the latter elements, whether (in accordance with Dulong and Petit's law) they have the same atomic heats, or whether the differences in the atomic heats cannot at present be shown with certainty.

The author gives for all compounds, whose specific heat has been investigated in a trustworthy manner, a comparison of the specific heats found experimentally with those calculated on the above assumption. The atomic heat of a compound is obtained by adding the atomic heats of the elements in it, and the specific heat by dividing this atomic heat by the atomic weight. The calculated specific heat of chloride of potassium, KCl, is $\frac{6.4 + 6.4}{74.6} = 0.172$; of sulphide of lead, PbS, $\frac{6.4 + 5.4}{239} = 0.0494$; of borate of potass, KB Θ_3 , it is $\frac{6.4 + 2.7 + (2 \times 4)}{82} = 0.209$; of tartaric acid, C Θ_4 H Θ_6 , it is $\frac{(4 \times 1.8) + (6 \times 2.3) + 6 \times 4}{150} = 0.300$.

A table, embracing 200 compounds, shows, on the whole, a sufficient agreement between the calculated and the observed specific heats. The author remarks that a closer agreement between calculation and observation cannot be hoped than that between the observed atomic heats of such compounds, for which, from all we know at present, the same atomic heat is to be expected in conformity with Neumann's law, to which, in such cases, of course, calculation corresponds. In only a few cases are differences between calculation and observation met with which exceed these limits, or exceed the deviation between the results of different observers for the same substance.

If calculation of the specific heat does not supersede the necessity of experimental determination in the solid state, and does not give a trustworthy measure for the accuracy of such determinations, it gives a rough control for the experimental determinations, and it indicates sources of error in the experiments, which, without it, would not have been noticed. An instance may be adduced. The author found for sesquichloride of carbon C Θ_2 Cl Θ_6 , which, according to Faraday, melts at 160°, the specific heat, between 20° and 50°, to be 0.276 in one series of experiments, and 0.265 in another. Hence the number 0.27 might from this be taken to express the specific heat of the compound. But calculation gives $\frac{(2 \times 1.8) + (6 \times 6.4)}{237} = 0.177$, a very different number. A

third series of experiments, with substance once more recrystallised, gave for the specific heat between 21° and 49° 0.278, confirming the previous determinations. It

might here appear doubtful whether calculation was not refuted by experiment. The discrepancy was removed by the observation that the substance is distinctly more viscous at 50° than it is at lower temperatures, and by the suspicion that it might at 50° , that is, 100° below its melting-point, already absorb some of its latent heat of vitreous fusion. This was found to be the case; two concordant series of experiments gave as the mean of the specific heat the numbers:—

Between 18° and 37°	0.178
Between 18° and 43°	0.194
Between 18° and 50°	0.277

The first two numbers differ so little that it may be supposed the number found for temperatures below 37° is very near the true specific heat of this compound; it also agrees well with the calculated number.

In the sixth part of his paper the author enters into considerations on the nature of the chemical elements.

He calls to mind the discrepancy which has prevailed, and still prevails, in reference to certain bodies, between their actual indecomposability and the considerations, based on analogy, according to which they were held to be compound. Even after Davy had long proclaimed the elementary nature of chlorine it was maintained that it contained oxygen. In regard both to that substance and to bromine and iodine, the view that they are peroxides of unknown elements still finds defenders. That iodine, by a direct determination of specific heat, and chlorine, by indirect deduction, are found to have an atomic heat in accordance with Dulong and Petit's law puts out of doubt that iodine and chlorine, if compound at all, are not more so than the other elements to which this law is considered to apply.

According to Dulong and Petit's law, compounds of analogous atomic composition have approximately equal atomic heats. In general, compounds whose atom consists of a larger number of undecomposable atoms, or is of more complex constitution, have greater atomic heat. Especially in those compounds all of whose elements follow Dulong and Petit's law is the magnitude of the atomic heat a measure of the complication or of the degree of complication. If Dulong and Petit's law were universally valid, it might be concluded with great certainty that the so-called elements, if they are really compounds of unknown simpler substances, are compounds of the same order. It would be a remarkable result if the art of chemical decomposition had everywhere reached its limits at such bodies, which, if at all compound, have the same degree of composition. Let us imagine the simplest bodies, perhaps as yet unknown to us, the true chemical elements, to form a horizontal layer, and above them to be arranged the more simple and then the more complicated compounds; the general validity of Dulong and Petit's law would include the proof that all the elements at present assumed to be such by chemists lay in the same layer, and that in admitting hydrogen, oxygen, sulphur, chlorine, and the various metals as elements, chemistry has penetrated to the same depth in that range of inquiry, and has found at the same depth the limit to its advance.

But with the proof that this law is not universally true, the conclusion to which this result leads loses its authority. If we start from the elements at present assumed in chemistry, we must admit rather that the magnitude of the atomic heat of a body does not depend on the number of elementary atoms contained in a molecule or in the complication of its composition, but on the atomic heat of the elementary atoms which enter into its composition. It is possible that a decomposable body

may have the same atomic heat as an element. Chlorine might certainly be the peroxide of an unknown element which had the atomic heat of hydrogen. The atomic heat of peroxide of hydrogen, H_2O , in the solid state or in solid compounds, must be $= 2.3 + 4 = 6.3$, agreeing very nearly with the atomic heats of iodine, chlorine, and the elements which follow Dulong and Petit's law.

In a very great number of compounds the atomic heat gives more or less accurately a measure for the complication of the composition. And this is also the case with those compounds which, from their chemical deportment, are comparable to the undecomposed bodies. If ammonium or cyanogen had not been decomposed, or could not be by the chemical means at present available, the greater atomic heats of the compounds of these bodies, as compared with analogous potassium or chlorine compounds, and the greater atomic heats of ammonium and cyanogen obtained by indirect determination, as compared with those of potassium and chlorine, would indicate the compound nature of those so-called compound radicals. The conclusion appears legitimate, that for the so-called elements the directly or indirectly determined atomic heats are a measure for the complication of their composition. Carbon and hydrogen, for example, if not themselves actually simple bodies, are yet simpler compounds of unknown elements than silicium or oxygen, and still more complex are the elements which may be considered as following Dulong and Petit's law.

It may appear surprising, and even improbable, that so-called elements, which can replace each other in compounds, as, for instance, hydrogen and the metals, or which enter into isomorphous compounds as corresponding elements, like silicium and tin, should possess unequal atomic heats and unequal complication of composition. But this really is not more surprising than that undecomposable bodies and obviously compound bodies, hydrogen and hyponitric acid, or potassium and ammonium, should, without altering the chemical character of the compound, replace one another, or even be present in isomorphous compounds as corresponding constituents.

The author concludes his memoir with the following words:—"I have here expressed opinions in reference to the nature of the so-called elements, which appear to depend upon allowable conclusions from well-demonstrated principles. It is of the nature of the case that with these opinions the certain basis of the actual and of what can be empirically proved is left. It must also not be forgotten that these conclusions only give some sort of clue as to which of the present undecomposable bodies are of more complicated and which of simpler composition, and nothing as to what the simpler substances are which are contained in the more complicated. Consideration of the atomic heats may declare something as to the structure of a compound atom, but can give no information as to the qualitative nature of the simpler substances used in the construction of the compound atoms. But even if these conclusions are not free from uncertainty and imperfection, they appear to me worthy of attention in a subject which is still so shrouded in darkness as the nature of the undecomposed bodies."

PHOTOGRAPHY.

On the Application of Potassio-Ammonium Chromate to Photography, by E. KOPP.

(Continued from Vol. IX., page 296.)

ALL the chromic acid is dissolved, and only oxide of chromium remains as residue by prolonged washing

simply in water, either pure, alkaline, or even simply calcareous.

For this reason the washing of photographs should not be carried too far. Otherwise the brown image will become paler and paler, until it retains only the light-greenish tint of hydrate of oxide of chromium.

This ready alteration of the compound CrO_2 becomes in this respect a disadvantage, while in other respects it is equally an advantage.

It allows the employment of operations of a very different nature to strengthen the image, and fix it permanently and unalterably.

In fact, with the superoxide there are instantaneously fixed on the paper both chromic acid and oxide of chromium, and each of these two compounds, possessing a colouring power much more intense than that of CrO_2 , is capable of entering into new combinations.

1. If it is desired to fix chromic acid we have but to submit the paper with the image, previously washed, to the action of solutions of metallic salts capable of forming insoluble chromates (even in a slightly acid liquid) and highly coloured; such are the chromates of lead, bismuth, silver, mercury, &c.

Thus, to cite but one instance, by shaking the photographs in a very weak but bright and limpid solution of mercurous nitrate, as neutral as possible, the image almost immediately assumes a decided orange-brownish red tint, produced by the formation of mercurous chromate.

With a salt of lead or bismuth the image would be yellow; with a salt of silver, crimson, &c.

But the transformation is not thus limited; the image once fixed in the state of insoluble metallic chromate, it may be washed perfectly, in order to remove all trace of soluble metallic salt from the white parts, and nothing then prevents its undergoing the action of sulphuretted hydrogen, or alkaline sulphides, and the yellow, orange, or reddish-brown tints turned to more or less deep black.

By this manner of operating it is evident that chromic superoxide furnishes the means of fixing on the paper, in quantities proportional to the intensity of the shades, various metallic salts which, once fixed, may be made apparent by various reactions if, in the state of chromate, the image is not of the desired tint.

As reactions accompanied by phenomena of colour are extremely numerous and varied with the proper metals, which are precisely those which become fixed under the above circumstances, it is not unreasonable to suppose that among them some may be practically utilised. To give but one instance,—by plunging the image formed by mercurous chromate into a weak solution of hyposulphite of soda the orange-brown will be observed to turn to black immediately, more or less brownish or greyish, consequent on the formation of black sulphide of mercury.

2. Setting aside chromic acid, new effects may be obtained by operating on the chromic oxide resulting from the alteration of CrO_2 .

We have already observed that by leaving the image formed by CrO_2 for a long time in water, especially in calcareous water, all the chromic acid gradually disappears, and only hydrate of oxide of chromium remains on the paper. This result is obtained much more rapidly by washing with a diluted and warm solution of carbonate of soda, ammonia, or any other salt with an alkaline reaction, always finishing by washing in pure water.

But the hydrate of oxide of chromium serves as a mordant, and it follows that on plunging the paper thus

modified into a bath containing a colouring matter susceptible of fixation by the mordant of chromium that an image will turn from its original pale green to the tints produced by this mordant.

The colouring matters serving for this purpose being very numerous, such as alizarine, purpurine, Brazil, logwood, fustic, &c., &c., very varied effects can, of course, be produced.

Logwood is especially fit for this purpose.

It is by no means necessary that CrO_2 should be entirely transformed into Cr_2O_3 ; it suffices to wash it until no undecomposed chromate remains on or in the fibre of the paper. The small quantity of chromic acid remaining combined with the oxide of chromium operates favourably in modifying the tint of the logwood to bluish black. Also, after a certain period of immersion in a bath of logwood recently prepared, and hot, the image becomes very dark bluish black. The white parts even become much coloured after a time, but they are easily restored. After the dyed paper has been washed, it is plunged into a very weak and tepid solution of chloride of lime, where the undyed parts become rapidly white, and the image reappears. The reaction is brought to an end when the desired tint appears; the paper is then washed and dried.

With other colouring matters the operation is conducted in much the same manner, subject to modification according to circumstances and the peculiar nature of the dye. Paper, however close and strong it may be, is, for this kind of preparation, very inconvenient. In prolonged washing in water, especially in hot water, the fibres are raised, and the image loses some of its distinctness; besides, the paper almost always contains some mineral matters, such as alum, chalk, &c., possessing an affinity, more or less marked, for the colouring matter.

These defects are inherent to the nature of ordinary paper, and, to obviate them, it would perhaps be better to use a paper specially prepared; for instance, parchment paper, so that the fibres could not be easily separated, and that they might be free from matters capable of taking the place of mordants.

There is evidently no reason why a more or less fine cloth should not be substituted for paper and operated upon in the same manner. The reactions we have described may be regarded as constituting one of the phases of the application of photography to the production of designs on tissues. Many manipulations difficult, if not impossible, on paper, are perfectly easy on cotton, woollen, or silk materials.

3. The compound CrO_2 fixed on paper and cloth has yet another series of reactions, several of which may be utilised.

They are founded on the property possessed by CrO_2 of acting as a superoxide readily abandoning its oxygen, becoming an oxide, and consequently exercising a strongly oxidising action.

By putting in contact with CrO_2 a body which, while oxidising, forms an insoluble compound, this compound will become fixed at every point where it encounters chromic superoxide.

Among organic compounds there are several which answer this purpose, and which besides assume more or less dark tints, such, for instance, as certain pyrogenic acid, astringent substances, several naphtha and anilic combinations, &c.

They are equally to be found among minerals, and to give but one example we will mention that by plunging a paper coloured by CrO_2 in a weak, cold, and perfectly neutral solution of a ferrous salt (sulphate or chloride)

it will after a time be found that oxide of iron is precipitated on all the parts impregnated with chromic superoxide. Oxide of iron may then in its turn serve as a starting point for a whole series of changes of colour, either by a dyeing process or as a consequence of the production of ferrous combinations, presenting their characteristic colorations (Prussian blue among others).

By associating other easily altered salts, such as yellow or red prussiates, with potassio-ammoniacal chromate varied effects may be obtained, and images allowing other kinds of transformations. Thus, for example, a mixture of solution of yellow prussiate, ammoniac chloride and potassio-ammoniac chromate, with which the paper must be covered or impregnated, gives, after insolation and washing, a yellowish-brown image, which, under the influence of a very neutral and diluted solution of a ferrous salt, gives images of a very agreeable shade, which images may be modified in many ways.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

GELATINE, GLUE, BONE-SIZE, CHONDRINE, their preparation, chemical properties, nutritive value, and application to arts and manufactures. Artificial tortoiseshell. *Isinglass*, its adulterations and adaptations to the clarification of fluids. *Skins* and the art of tanning.

LECTURE II.

DELIVERED ON THURSDAY EVENING, APRIL 7, 1864.

As the syllabus will show you, I intend to draw your attention, especially in this lecture, to gelatinous substances, as well as to the art of tanning. There are four distinct gelatinous substances obtained on a commercial scale from animal tissues and bones, viz.,—*Osséine*, which I mentioned in my last lecture, *Gelatine*, *Chondrine*, and *Isinglass*.

Osséine, as already stated, is the animal matter existing in bones, and no doubt it is the same substance which also exists in skins, both during life and when recently removed from the animal. It is characterised by its insolubility, its inability to combine with tannin, and lastly, the facility with which it undergoes a molecular change, and becomes converted into *gelatine*, slowly, when boiled with water at 212° , rapidly, when boiled under pressure at a higher temperature, and very gradually under the influence of putrefaction.

Gelatine is a solid semi-transparent substance, which absorbs water in large quantities (40 per cent.), becoming thereby transparent. It is very slightly soluble in cold water, but very soluble in boiling water; and this solution has the characteristic property of forming a jelly on cooling. So powerful is *gelatine* in solidifying water, that one part of *gelatine* will form a jelly with 100 parts of water. It has been observed that *gelatine* loses this valuable property if boiled for a long time at ordinary pressure, or if carried to a temperature above 223° F. Before examining the interesting action of acids upon *gelatine*, allow me to mention that whilst solid *gelatine* resists putrefaction for a long time, its solutions have a tendency to putrefy rapidly, but I have the pleasure to inform you that a few drops of a substance called carbolic acid will prevent putrefaction for a long period. *Gelatine* dissolves rapidly in acetic acid, of moderate strength, or vinegar, and this solution, which is used as glue, has the useful property of remaining fluid and sound for some time. But a Frenchman, named Demoulin, has introduced of late years in Paris a solution of glue which is superior to the above and to that in common use, because it does away with the trouble of constantly heating the glue-pot. His process consists in melting one pound

of best glue in one pound of water, and adding gradually to the two one ounce of nitric acid of sp. gr. 1.36, heating the whole for a short time, when the fluid glue is prepared. The action of concentrated nitric acid on *gelatine* is most violent, giving rise to several compounds, amongst which may be cited oxalic acid. The action of sulphuric acid on *gelatine* is important in a scientific point of view, as an alkaloid called leucine is produced, as well as a sweet substance, called glycolle, or sugar of *gelatine*. *Gelatine* is distinguished from other organic substances by the following chemical reactions:—it gives a white precipitate with alcohol, also with chlorine, none with gallic acid, but one with tannin, or tannic acid. The properties of this precipitate are most important to us, as it is on the formation of it in hides that we ascribe their conversion into leather. The relative proportion of these two substances (*gelatine* and tannin) in the precipitate varies with the respective proportions brought in contact, but precipitates containing as much as 46 per cent. of tannin have been examined. It is insoluble in water, and presents the invaluable character of not entering into putrefaction. Beautiful fancy ornaments have recently been introduced in Paris by M. Pinson, called artificial tortoiseshell, which he obtains by melting, at a moderate temperature, *gelatine* with a small amount of metallic salts, running the whole into moulds, staining the mass with hydro-sulphate of ammonia, so as to produce an imitation of the grain of tortoiseshell. The objects so produced are then polished and ready for sale. Before entering on the manufacture of various qualities of *gelatine*, I should wish to state that there can be no doubt, from the researches of Magendie, as well as from the Report of the Commission appointed by the Netherlands Academy of Sciences, that *gelatine* as food possesses no nutritive value whatever. Allow me now to give you a rapid outline of the methods followed in the manufacture of various qualities of *gelatine*. The first quality of *gelatine* is prepared by taking the clippings, scrapings, and fleshings from the tanyard, treating them with lime water or alkali, to remove any smell and certain impurities. They are then well washed and left in contact for a day or two with a solution of sulphurous acid. They are then placed in a suitable apparatus with water, and heated, when the *osséine* is converted into *gelatine*. This is run into a second vessel, and a little alum added, to throw down any impurities that may be in suspension. The liquor is now ready to be run into another pan, where it is concentrated to the necessary consistency, so as to become solid when it is run into wooden moulds. Eighteen hours afterwards the *gelatine* is turned out of these moulds on to a wet slab, where it is cut into slices by means of a copper wire; these slices are placed on wire gauze frames, and left in a drying shed until they are perfectly dry and ready for the requirements of trade. The second quality of *gelatine* is prepared by placing bones in large cylinders, and allowing high-pressure steam to arrive at the bottom of the cylinder, which rapidly converts the *osséine* of the bones into *gelatine*, and the removal of this is facilitated by allowing a stream of hot water to enter the upper part of the cylinder. The solution of *gelatine* thus obtained is evaporated, and is usually employed for the preparation of glue. A third quality is prepared by treating bones with hydrochloric acid (as referred to in my first lecture), and submitting the *osséine* thus obtained to the action of steam. Lastly, a fourth quality of *gelatine*, called bone-size, is manufactured by boiling more or less decayed bones, as imported from South America and elsewhere, the flesh of dead animals, &c., and concentrating the solution to the consistency required for the various applications it receives in commerce. [The lecturer then described the mode of obtaining the beautiful thin coloured sheets of *gelatine* used in photography and other fancy purposes, and also the characteristics which distinguished good from bad glues.]

Chondrine, or cartilage *gelatine*, first noticed by Messrs.

Müller and Vögel, jun., is interesting as possessing qualities, not only different from those of gelatine, but such as injure the quality of the latter when mixed with it. In fact, it gives precipitates with acetic acid, alum, persulphate of iron, and other salts; and as gelatine is often used in connexion with these substances, it is easy to foresee how these precipitates may interfere with its application. On the other hand, the quality possessed by this peculiar gelatine, may, I think, render it serviceable in the art of calico printing, for fixing colours, or as a substitute for albumen or lactarine. Thus, the solution of chondrine and acetic acid may be mixed with any of the new tar colours, and the whole printed, allowed to dry, and steamed; the acetic acid will be driven off, leaving the colour fixed by the chondrine on the fabric. Chondrine is prepared by submitting to the action of heat and water the cartilaginous tissue of animals or the bones of young animals.

Isinglass is obtained from the air-bag or swimming-bladder of several kinds of fish, especially those of the sturgeon tribe, and, although imported from various parts of the world, the principal supplies are from Russia, from whence the best qualities come, which bear the names of Beluga, Volga, or Caspian Sea leaf. Brazil, New York, the East Indies, and Hudson's Bay, also supply various qualities of this valuable substance. It also reaches this country in different states—viz., in leaf and in honeycomb, that is, the bag is cut open, cleaned and dried; and the quality called snow-bleached is enhanced in value by having been buried in the snow on the banks of the Volga for a long period, by which the isinglass is whitened. Pipes, purses, and lumps are bags which have been cleared but not opened; and a quality called ribbons is made by rolling the bag and cutting it into strips before shipping it to this country.

I shall now endeavour to explain to you how the beautiful preparations before you, for which I am indebted to the kindness of Mr. James Vickers, are obtained. The leaf bladder is first softened in water, and rolled out, under high pressure, into thin leaves, which may extend to several feet long; these in their turn are drawn under a number of revolving knives, making 1000 revolutions per minute, by which 6000 of the well-known fine threads are produced in every minute. This quality is chiefly used for culinary purposes. For commercial uses the purses or lumps above mentioned are chiefly employed. These are soaked in water for two or three days, cut open, certain useless parts removed, further softened, rolled, and cut into various dimensions, according to the requirements of trade, their chief use being the clarification of beer and other alcoholic fluids, for which gelatine cannot be employed, because it dissolves in water, whilst isinglass merely swells. The result is that the highly-swollen and extended mass, when poured into beer, wine, or other alcoholic fluids, is on the one hand contracted by their alcohol, and on the other hand it combines with their tannin, forming an insoluble precipitate, which, as it falls through the liquor, carries with it the impurities in suspension, and thus clarifies the fluid. As isinglass is very slow in swelling out in water, brewers employ an acid fluid for the purpose, but, strange to say, instead of using pure acetic acid, many of them take sour beer, and thus run the great risk of spoiling their sound beer. I have known instances of great losses occurring in this way, acetous fermentation having been thus spread through an entire brewery during the summer months. As a large quantity of gelatine, cut into shreds, in imitation of isinglass, is sold at the present day, it may be useful to know that detection is very easy by the following method:—Place a small quantity in hot water, in which gelatine will readily dissolve, whilst isinglass will do so very slowly. I cannot conclude the examination of this interesting class of substances without drawing your attention to the fact that osséine, gelatine, chondrine, and isinglass present marked differences in their

textures and general properties, although their chemical compositions may be considered identical, thus:—

	Osséine.	Gelatine.	Chondrine.	Isinglass.
Carbon	50.4	50.0	50.61	50.56
Hydrogen	6.5	6.5	6.58	6.90
Nitrogen	16.9	17.5	15.44	17.79
Oxygen	26.2	26.0	27.37	24.75

Esculent Nests.—I must not omit to mention, in connection with this interesting class of substances, these curious gelatinous products, which are not only considered great delicacies in China, India, but even in Europe, where they realise from £3 to £7 per pound; considerable quantities are imported into England. It has long been a disputed question what is the chemical nature of the substance composing these nests, which are the product of a peculiar kind of swallow; but Mr. Payen, by his recent researches, has left no doubt in the minds of chemists that it is an animal, not a vegetable matter. In fact, it is a peculiar mucous substance, secreted by the bird, and composed of carbon, hydrogen, oxygen, nitrogen, and sulphur. Further, it is insoluble in cold water, but soluble in boiling, and differs from gelatine and isinglass in that it does not gelatinise as it cools.

Skins.—Skin consists of two principal parts, one a mere film, called the epidermis, and the other constituting the bulk of the skin, and called the dermis. There are also found in skin a large quantity of blood-vessels, and a small quantity of pigment cells, which hold the colouring matter. Further, the skin contains a small amount of nerves and a number of glands, among which may be cited the sebaceous glands or follicles, which are intended to secrete the unctuous matter constantly accumulating upon the skin, and keeping it soft and pliable; then there are the perspiratory glands, which play a most important part in the physiological construction of the skin. These are so numerous that Mr. Erasmus Wilson has calculated that there are 3528 of them in a single square inch of human skin, so that in an ordinary sized body there are no less than 2,300,000 of these pores. But still the most important part of the hide for us is that called the "dermis." The skins of animals are commercially divided into three distinct classes. The hide is the name given to the skin of full-grown animals, such as oxen, horses, and buffaloes; and these are further sub-divided into fresh hides, that is to say, those which are obtained from animals slaughtered in this country; dry hides, that is, hides which have been dried in the sun, and which are principally imported from South America; dry salted hides, principally from the Brazils, where they are salted and then dried in the sun; and salted hides, which are preserved in Monte Video and Buenos Ayres by salting them, and which are shipped, embedded in salt, to this country. The composition of a fresh hide may be considered to be as follows:—

Real skin	32.53
Albumen	1.54
Animal matters soluble in alcohol	0.83
Animal matters soluble in cold water	7.60
Water	57.50
	100.00

A second class of hides is that called kips, which are skins flayed from the same kinds of animal as the foregoing, only when young. Thirdly, the term skin is applied to those of small animals, such as the sheep, goat, seal, &c.

I will now endeavour to give you an idea of the preparation which hides undergo to fit them for the art of tanning. These operations are four. The first consists in washing off the dirt from the hide, softening it, if a dried one, or removing the salt, if salted. The second has for its object the removal of the hair, which is effected by two or three different methods. The most usual plan is to place the hides in large vats, containing a weak milk of lime, for two or three weeks, care being taken to remove and replace

them every other day, after which time the hair is sufficiently loosened to be removed. A second plan consists in piling up the hides, allowing them to enter slightly into a state of putrefaction, and then placing them in weak milk of lime, so as to complete not only the loosening of the hair, but also the swelling of the hide, for lime also possesses that property. Another process, which is called the American plan, is to hang the hides in pits for two or three weeks, keeping them at a temperature of 60°, and constantly wet, when the hair can be easily removed. Weak alkalies are sometimes substituted with great advantage for lime in the above processes, and this plan is certainly the best, as it does not leave in the hide any mineral residue, as is the case with lime, either in the form of an insoluble soap of lime or of carbonate, both of which are highly objectionable in the subsequent process of tanning, as they act on the tannic acid of the tan, facilitating its oxidation, and thereby rendering it useless. Depilation of hides is sometimes effected by the employment of weak organic acids; thus, the Calmuck Tartars have used from time immemorial sour milk for that purpose. In some parts of France, Belgium, and Germany, the unhairing of the skins is also effected by an acid fluid, produced by the fermentation of barley meal, which gives rise to acetic and lactic acids. To carry out this process, generally speaking, five vats are used. In the first the hides are cleaned; in the second they are softened, and the hair and epidermis prepared for depilation; and the third, fourth, and fifth are used to swell and give body to the hide. This operation, which is called white-dressing, does not work so well as lime for heavy hides, as it swells them to such an extent as to render them unfit to prepare compact leather. When the hair can be easily pulled off, the hides are placed on a convex board, called a beam, and scraped with a double-handed concave knife, which not only removes the hair, but a large amount of fatty lime-soap and other impurities from the hides. The third operation consists in fleshing the hides, by shaving off all useless flesh, fat, and other matter by means of a sharp tool. The fourth operation is called swelling or raising the hide, the purpose of which is the following:—First, the removal of any lime or alkali which may remain in the hide; and secondly, to swell or open the pores of the hide, so as to render them better adapted to absorb the tannic acid of the tanning liquors. This is effected by dipping the hides in weak spent tanning liquors, or liquors which have lost the tannic acid, but which contain more or less of gallic acid, for not only do all tanning matters contain gallic acid, but its proportion is greatly increased during the operation of tanning, by a process of fermentation which goes on during that operation, and which converts tannic acid into gallic acid and a peculiar sugar.

The Tanning of Hides.—The old process of tanning consisted in placing layers of wet tan and of hides alternately, and after two or three months removing the whole from the pit and replacing the old by fresh tan. These operations were repeated until the hides were tanned, which took from eighteen months to two years, owing to the difficulty of the tannic acid reaching the interior of the hide. Of late years the process of tanning has been greatly shortened by treating the bark with water, and steeping the hides in the liquor, first weak and afterwards strong. By this means good leather can be obtained in the space of eight or ten months. More rapid tanning, but probably giving inferior leather, is effected by employing, in conjunction with, or as a substitute for, bark, a decoction of dividivi, valonia, myrobalan, catechu or terra japonica, gambir, &c. Many efforts have been made of late years to apply the laws of hydraulics, as well as several physical and physiological principles discovered by eminent philosophers, with the view of shortening the period of tanning, but as I believe that none of them have received the general sanction of the trade, I shall confine

myself to giving you an idea of the most successful ones. The first attempt to accelerate the process of tanning consisted in forcing the tanning fluids into the substance of the hide by means of hydraulic pressure. Mr. Spilbury, in 1831, employed a process which consisted in making the hides into sacks, and plunging them into a tanning liquor, and as the fluid percolated through the skin into the interior of the bag the air was allowed to escape. By this means a certain amount of time was saved in bringing the tanning liquor in contact with the various parts of the skin. Mr. Drake soon followed in the same direction, his plan being to sew hides together, forming bags, which he filled with a solution of tan; and to prevent the distention of the skins by the pressure of the liquid within, they were supported in suitable frames; as the pores became gradually filled with tannin, artificial heat was applied to increase the percolation of the fluid. Messrs. Chaplin and Cox's process is also very similar to the above, the difference being that the tannin fluid is placed in a reservoir, and allowed to flow into the bag of hides through a pipe, the fluid being thus employed at pressures varying according to the height of the reservoir. The bag of hides is at the same time plunged into a solution of tannin to prevent excessive distention. Messrs. Knowles and Dewsbury have recourse to another principle to compel the percolation of the tanning liquor through the hide. To effect their purpose they cover vessels with hides, so as to form air-tight enclosures, and, having placed the tanning fluid they employ on the hides, the vessels are exhausted of air, and atmospheric pressure then forces the fluid through the skins into the vessels below. Mr. Turnbull's process, being an imitation of that used for tanning Morocco leather, need not be described. Attempts have been made from time to time to mineralise hides, that is to say, to substitute for tanning, mineral salts, as will be described in my next lecture, when speaking of the art of tawing skins. The processes which have attracted most notice in this branch of the art of preparing leather are those of Messrs. D'Arcet and Ashton, M. Bordier, and M. Cavalier. M. Bordier's plan is that of dipping hides in a solution of sesquisulphate of iron, when the animal matters of the hide gradually combine with a basic sesquisulphate of iron, rendering the hide imputrescible, and converting it into leather. M. Cavalier's method is to dip hides first into a solution of protosulphate of iron; and then into one containing alum and bichromate of potash. A chemical action ensues, by which the protosulphate of iron is converted into a persulphate, combining with the animal matter, and by its preservative action, together with that of some of the alum, the hide is converted into leather. I think, however, that I shall be able to satisfy you, from the results of many examinations of leather and hides which I have made, that there are good and sufficient reasons why most of these processes have necessarily failed. Inventors have been led to believe, by the statements of many eminent physiologists (as can be proved by reading some of the most recent works on that science), that skin is composed of blood-vessels, glands, &c., plus gelatine, and that if by any mechanical contrivance the tanning liquor could be brought into contact with this gelatine, the leather would be tanned; and many ingenious schemes have been devised, and much money expended, to obtain that result. The fact, however, is that there is no gelatine in skin, for if there were, when hides were placed in water, the gelatine would be dissolved and washed away. But what is supposed to be gelatine in the hides is in reality the isomeric substance called osséine, or one greatly resembling it. The great discovery to be made in the art of tanning, therefore, is that of a chemical or fermentative process, by which the isomeric change (that of the osséine into gelatine) may be rapidly produced, instead of by the slow putrefactive process which occurs in the old method of tanning. Further, I would observe that to convert a hide into leather it is not suffi-

cient that the whole of its animal matter be combined with tannin, for the leather thus obtained would present two great defects: 1st, the hide would not have increased in weight, and the tanner's profits, therefore, would suffer; 2ndly, the leather would be so porous as to be useless for many of the purposes for which leather is required. The reason of this is, that when, after a period of several months, the osséine has been converted into gelatine, and this has become thoroughly combined with tannin, a second series of reactions is necessary to render the leather more solid and less permeable to water, and to increase materially its weight. These reactions constitute what is called feeding the hide, and are brought about by leaving it to steep in more concentrated tanning liquor for a considerable period; and this necessary process, beneficial to the wearer as well as to the producer, appears to me to be that which offers the greatest impediment in the way of shortening the period of tanning. The hides as they leave the tanning vat require several operations before they are ready to be used for soles, or to be curried for various commercial purposes. They are first slightly washed and placed in a shed to partially dry, and are then rubbed with a brush and rough stone on the face of the leather, or hair side, to remove any loose tanning material that may remain on the surface; but this rubbing is not applied to the back, as buyers attach great importance to the peculiar appearance called the bloom, which enables them to judge of the goodness of the tanning. The tanned hides are again slightly dried, and oiled on the face, and then submitted to the pressure of a roller passed over the surface, which has the effect of rendering the leather more flexible, and the surface perfectly uniform. These operations are repeated two or three times, when the leather is ready for soles. Before the tanned hides intended for shoe-soles are considered fit for that purpose, they must be slightly compressed and softened, so as to again diminish their permeability to water. This was formerly effected by beating with a hammer called the mace, but of late years this slow process has been superseded by compressing machines; and I believe those most appreciated in the trade were invented by Messrs. Cox and Welsh, and Messrs. Iran and Schloss.

CHEMICAL SOCIETY.

Thursday, June 30.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,
in the Chair.

THE minutes of the previous meeting having been read and confirmed, and the several donations to the library announced, the President informed the meeting that he had just received a letter of apology from Mr. Way, accompanied by a medical certificate, according to which he was sorry to have to announce the serious indisposition and consequent absence of the lecturer. Mr. Way had, however, kindly sent forward the notes of his subject, and had deputed Mr. Evans to address the Society in his stead; and he would, therefore, at once call upon Mr. Evans to favour them with the written communication.

The author commenced by referring to a sweeping condemnation of British agriculture and the waste of fertilising material pronounced by Baron Liebig, and promulgated a short time since through the medium of the *Daily Telegraph* and the *Agricultural Gazette*. In the number for November 15, 1862, of the last-named journal appeared a quotation, which was read to the meeting. It warned the British farmer against relying upon the foreign and artificial sources of manure which this country has secured to itself in guano and other native phosphatic materials, and pointed out the necessity of restoring to the soil those mineral ingredients of which it is constantly being robbed by the growth and removal of crops. The modern system of town drainage was that, of course, which came more

particularly under Liebig's censure, and the exhaustion of the guano beds had been dwelt upon as a contingency not altogether remote. Some of these assertions had been met in a work entitled "The National Laws of Husbandry, 1863," and the author proposed to deal with these and other points in "The Philosophy of British Agriculture." It had usually been considered necessary that the ingredients of the soil should be rendered soluble before they could be assimilated by the roots of the plant; but Liebig, on the other hand, maintained that this need not always be the case, that even solid substances had the power of entering the vegetable organisms by endosmosis; and, further, he believed that nearly all the carbon was taken in through the roots, and hence he insisted on the decomposition of humus as affording direct nutriment to the plant, whilst the advantage of employing nitrogenous compounds to furnish ammonia was equally problematical. About the year 1850, Mr. Way made some experiments which resulted in the discovery that arable soils had the power of absorbing ammonia, and even of fixing phosphoric acid and the salts of potash. By causing an aqueous solution of sulphate of ammonia to percolate through clay and sandy soils, it was found that the lime contained therein combined with the sulphuric acid and liberated ammonia, which then was retained by the soil, and if a solution of phosphate of soda was passed through a stratum of clay, both the acid and basic constituents became fixed by the earthy matters of the soil. It appeared probable that a class of double silicates was formed similar in constitution to the alums, but which were but sparingly soluble in water. The existence of silicate of ammonia had been denied by Liebig, but it was a fact, nevertheless, that some sort of combination was possible, for both sand and clay absorbed large quantities of ammonia gas, and when soluble ammoniacal salts were brought into contact with the silicates of alumina and lime (or soda) a portion of the ammonia became fixed by these felspathic minerals, and soluble compounds of lime passed through. In this way a large series of double silicates had been formed containing always silicate of alumina in union with a silicate of lime, magnesia, potash, soda, or ammonia. These compounds being then slowly acted upon by water presented to the roots of the plant a ready formed combination of various bases such as they required for successful development. The author admitted a clerical error in the table accompanying his paper of 1850 which had been pointed out by Liebig, but he felt much satisfaction in finding that the eminent German chemist had afterwards, in his "Theory and Practice," published in August, 1853, given him (Mr. Way) credit for having first called attention to the power possessed by clay in absorbing ammonia. This action Liebig considered perfectly analogous to that of carbon in condensing ammonia vapours, and in depriving vegetable substances of their colour and odour. Again, it appeared that the earthy bases in clay removed the nitric acid from saltpetre, the potash then forming a kind of double silicate. Every farmer knows how difficult it is to affect the sub-soil by a top dressing of manure, and hence the practice of growing cereals and deep-rooted plants, such as clover, in series, so that the land may not become unduly exhausted. The accusation made by Liebig to the effect that the British farmers were injudiciously growing more produce on the land than was warranted by the return of the mineral constituents in the shape of manure, was, in the author's opinion, fully and satisfactorily answered by a comparison of the state of agriculture at the present day with that of fifty years ago, and during the latter part of this interval much valuable fertilising matter had been lost by sewage. According to the data collected by the Rugby Sewage Commission, it had been estimated that every individual caused the loss of fifteen pounds of ammonia per annum, and reckoning the cost of this with proportionate quantities of phosphoric acid and potash at ten shillings per individual per annum,

it appeared that, with our present population, the country suffered a default by sewage at the rate of five millions sterling. Against this large expenditure, the author estimated the value of imported manures (guano and bone phosphate) at three millions per annum, leaving a deficit of other two millions. In conclusion, the author referred to the discussion pending between Baron Liebig and Messrs. Lawes and Gilbert in reference to the so-called "mineral theory," the first of these authorities maintaining that it was only necessary to restore to the land the ashes of the plants raised thereon; whilst, on the other hand, the English chemists advocated the liberal use of ammonia or of guano manures containing large quantities of nitrogen. It seemed to be almost a matter of indifference whether the hydrogen or oxygen compounds of nitrogen were thus employed; in other words, the nitrates were equally fertilising with ammonia. The author could not help remarking that Liebig had recently changed his opinions respecting the advantages of ammonia; this base could not properly be included amongst the *mineral* constituents of the soil, which were at one time said to be all important, but now that its use had become so general, the great German chemist wished it to be ranked by the side of potash and soda, and maintained that in an agricultural sense "ammonia is a mineral."

The PRESIDENT proposed a vote of thanks to the author for the elaborate paper with which he had favoured the Society; and to Mr. Evans for acting as the mouthpiece on this occasion. He felt sure that the members would participate in expressing their regret at the unavoidable absence through illness of Mr. Way. The subject was one of great interest to many of the Fellows then present, and he trusted the several points would be fully discussed.

Mr. Alderman MECHI bore testimony to the interest and importance of the scientific matters brought forward by Mr. Way. He was himself a firm believer in the advantages to be derived from manurial irrigation. It must be remembered that our present system of house drainage is a comparatively recent invention, not more than twenty years old, and that forty years ago all the excreta of London was carried by barges as far as 150 miles along the coast for the benefit of the farmer. Every agriculturist well knows that if he takes crops off the land for two or three years in succession he cannot maintain the fertility of the soil without restoring the constituents which have been removed. The great question is, therefore, "How is it to be done?" If three millions of sheep were feeding on pasture and were not allowed to manure on the land, every one would say, what a great folly! The speaker had himself sent up to the London market ten acres' yield of peas, but they would not go far towards supplying London's want; in twenty-four hours all and many more would be consumed. It had, indeed, been estimated that 6,000,000 of acres were required to be cultivated in order to supply food for London alone. The rate of exhaustion of the land must then be very great, and so little manurial refuse is returned from the metropolis, that the farmer has to go abroad for his supply of manure to compensate him for this tremendous waste. A Committee of the House of Commons was now inquiring into some of these matters, and it has been calculated that ten inches of rain, or half a year's fall, in Essex, weighing 1000 tons, might be raised 300 feet for an expense of thirteen or fourteen shillings. These facts were promising, but Liebig objected to irrigation and land drainage, because the action of the water was supposed to remove the soluble salts. Mr. Way had, on the other hand, brought forward facts to prove that this was not the case, and the speaker strongly advocated the importance of directing capital to the great desideratum—viz., that of distributing, in the cheapest possible manner, the sewage waters of London over the cultivated lands of Essex and other counties in the neighbourhood of the metropolis. Now that 1000*l.* per yard was being expended upon railways, it must surely be worth while considering

the policy of paying at the rate even of 30*l.* per yard for taking sewage into the country. A fall of five feet in the mile was sufficient in the case of the Loch Katrine water supply to Glasgow, and their works extended forty miles.

The remarks offered by Dr. Voelcher and Dr. Gilbert will be reported in our next. The President then adjourned the meeting until after the recess.

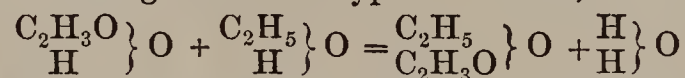
LECTURES ON CHEMICAL PHILOSOPHY.—I.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 8.)

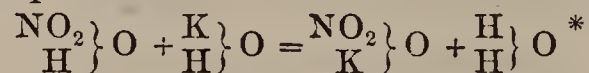
It is proper to say that Gerhardt changed the opinions he before held when he adopted typical formulæ. Up to that time he had considered as scientific only the crude formulæ: a chemical compound he had regarded as a *whole*, in which the elements were combined one with another without any particular arrangement. Hence came originally the name *unitary system* which was given to his doctrine. For example, he represented acetic acid as $C_2H_4O_2$, and alcohol as C_2H_6O , and he explained the formation of acetic ether as the union of these two bodies with the elimination of water.

Such was the way in which he at first interpreted chemical facts: it contrasts singularly with his second method, as we shall see without difficulty. The second method rests on a far more complete view of the phenomena, and a much more natural apprehension of the laws of chemistry. Compare the crude formula by which the formation of acetic ether was explained—a formula which explains nothing—with the typical formula, as under,—



And it will be seen that this second expression, so much clearer and more true, shows that the metamorphosis in this case is really a double decomposition.

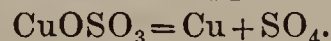
The same views adapt themselves without difficulty to mineral chemistry. Thus, in the formation of nitrate of potash by nitric acid and potash, there is no molecular addition, but a double decomposition, as is shown by the following equation:—



Here it is seen that nitrate of potash is formed in consequence of a double decomposition. According to Gerhardt, all salts are formed in a similar way; but this, as is easily proved, is an exaggeration.

We see now that the differences between the dualistic and the new theory are most clearly seen in the different ways in which they regard the constitution of salts. Dualism represents these as containing the elements of an anhydrous acid in juxtaposition with those of an anhydrous oxide, and this view seems to be supported by the decomposition which they undergo under the influence of the galvanic battery. It is said, for example, that sulphate of soda decomposes into sulphuric acid and soda, but it is not so.

We know that sulphate of copper, when submitted to the current, decomposes into copper and SO_4 .



The decomposition of sulphate of soda, which the dualist quotes in support of his views, is exactly analogous— SO_3, NaO decomposes into SO_4 and Na . (The proof of this is the fact that when mercury is placed at the electrode, an amalgam is obtained.) Afterwards, and by virtue of a secondary action, Na decomposes some water, and forms NaO ; at the same time SO_4 splits up into SO_3 , which appropriates the elements of water, and O which escapes. There is, then, a double and not a simple decom-

* It is hardly necessary to point out that in these lectures the author adopts the equivalents $C = 12$, $O = 16$, &c. We have not thought it necessary to indicate this by any change of type, since the context will sufficiently show the fact.

position, and the formula SO_4Na better represents the facts of the electrolysis of sulphate of soda than the formula SO_3NaO .

But, the dualists will say, the proof that a salt may be composed of an acid and a base,—the proof of dualism—is to be found in the fact that the vapours of anhydrous sulphuric acid, SO_3 , in passing over baryta, BaO , heated to redness, will produce sulphate of baryta, SO_3BaO .

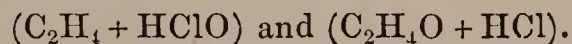
Gentlemen, these syntheses prove nothing concerning the constitution of compound bodies.

We can produce sulphate of lead by combining the bin-oxide, PbO_2 , with sulphurous acid, SO_2 . Shall we argue from that that sulphate of lead, SO_4Pb , contains $\text{SO}_2 + \text{PbO}_2$? Not at all.

Berthelot has produced formic acid by the synthesis of carbonic oxide and water. Shall we contend that formic acid contains carbonic oxide and water?

Carius has formed glycol, $\text{C}_2\text{H}_6\text{O}_2$, by combining olefiant gas, C_2H_4 , with oxygenated water, H_2O_2 ; but no one has ever pretended that it would be correct to represent glycol as a binary compound of oxygenated water and ethylene.

Again, Carius has obtained chlorhydric ethelenic ether by the synthesis of ethylene C_2H_4 and hypochlorous acid gas HClO . On the other hand, I have formed the same compound by uniting oxide of ethylene with hydrochloric acid. We have thus for chlorhydric-ethelenic ether, the two dualistic formulæ—



Which is correct?

These facts demonstrate that synthesis does not permit us to pronounce upon the atomic grouping of a compound. Although sulphate of barium is formed by the addition of the elements of sulphuric acid to the elements of oxide of barium, let us guard against drawing the conclusion that sulphate of barium contains ready formed and juxtaposed the elements of $\text{SO}_3 + \text{BaO}$.

This manner of representing its constitution is an hypothesis and nothing more. An ingenious and convenient hypothesis certainly, and one which has rendered great service to science; but still only an hypothesis, and not a demonstrated truth.

Berzelius has said that the use of an hypothesis begets a belief in its truth, hides its weak sides, and prevents the mind from appreciating adverse facts—a profound observation which seems to me to be especially applicable to the dualistic notions held by the illustrious Swedish chemist.

ACADEMY OF SCIENCES.

July 6.

M. BECQUEREL presented a memoir "*On the Preservation of Iron and Copper in the Sea.*" The author has borrowed from Davy the idea of protecting the metallic covering of ships by disposing bands of another metal (zinc) or an alloy around the vessel.

M. Pelouze contributed a short paper "*On the Saponification of Fatty Bodies by Alkaline Sulphides.*" Monosulphide of sodium the author found to completely saponify olive oil in the cold in about six days. He suggests that this, or a sulphide obtained by reducing sulphate of soda with charcoal, may be used industrially, and thinks that the low cost of this salt in comparison with caustic soda will allow of a little extra trouble to remove any disagreeable sulphur compounds from the soap.

Apropos to this paper, M. Chevrueil made some remarks on saponification and the neutrality of salts.

M. Hétet presented a paper "*On the Chemistry of Cotyledon Umbilicus,*" in which he states he has detected the presence of trimethylamine.

M. Hugo Schiff read a paper "*On some Phenic Derivatives of the Aldehydes.*"

A note by M. Debray "*On the Production of some Crystallised Arseniates and Phosphates*" gives an interesting

account of a method of obtaining crystals from the amorphous gelatinous precipitates of these compounds. The amorphous precipitates produced by soluble phosphates in metallic solutions are not absolutely insoluble in the liquor in which they are found. If, then, by lowering the temperature the solubility is diminished, a part crystallises on the sides of the glass. When the temperature is raised again more of the gelatinous precipitate is dissolved; and thus by alternately heating and cooling the liquor, the whole of the precipitate may be obtained in crystals—in some instances of considerable size. In this way M. Debray has made a number of double phosphates.

M. Deville announced that he had obtained crystals of chloride of silver by sealing it in a tube with dilute hydrochloric acid, and leaving the tube exposed to a variable temperature for two years.

M. Bechamp described a "*New Mode of Purifying the Heavy Oils from Tar, and a New Hydrocarbon from Coal Tar.*" The author finds that bichloride of tin will separate the bases of coal tar, and so allow a larger quantity of benzine to be distilled. The new hydrocarbon boils from 139° to 140° . M. Bechamp gives no further description at present.

M. Lorin announced that he had obtained *framide* by the distillation of formiate of ammonia.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1453. George Rydill, Dewsbury, Yorkshire, "Improvements in treating mixed fabric rags containing vegetable and animal fibre, and known in the trade as unsew skirtings, shallies, frieze, serge, extract wood, shoddies, and waste, to destroy the cotton and obtain a yellow colour, and give a milling or felting property to extract rags and extract material.—Petition recorded June 11, 1864.

1301. John Baird and John McIntyre, Alexandria, Dumbartonshire, N.B., "Certain improvements in apparatus employed for clearing and bleaching textile fabrics."—Petition recorded May 25, 1864.

1374. William Clark, Chancery Lane, Middlesex, "Improvements in the mode of heating animal, vegetable, and mineral matters, whereby to effect their desiccation, vaporisation, decomposition, reduction, fusion, or volatilisation, and in apparatus for the same."—A communication from Henri Adolphe Archereau, Boulevard St. Martin, Paris.—Petition recorded June 2, 1864.

1498. George Hyacinthe Ozouf, Rue St. Appoline, Paris, France, "Improvements in the manufacture and utilisation of carbonic acid, and in apparatus connected therewith."—Petition recorded June 16, 1864.

1507. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for washing or dyeing skeins of thread, silk, cotton, and other fibrous materials."—A communication from Claude Verèt, Boulevard St. Martin, Paris.

1509. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "The manufacture of lyes or liquors applicable to the cleansing and bleaching of wool and other fibrous substances, as well as of textile fabrics."—A communication from Madame Rosine Saiglan Bagnères, Paris, France.

1510. Thomas Townsend Coughin, Crucifix Lane, Bermondsey, Surrey, "Improvements in apparatus for compressing air or gases to be applied to various useful substances."

1513. William Henry Tooth, Rhodeswell Road, Stepney, Middlesex, "Improvements in furnaces or apparatus for generating carburetted hydrogen, carbonic acid, carbonic oxide, and cyanogen gases."

1514. William Henry Tooth, Rhodeswell Road, Stepney,

Middlesex, "Improvements in the manufacture and refining of iron, and in the manufacture of steel."—Petitions recorded June 17, 1864.

1525. Richard Smith and Christian Sieberg, Glasgow, N.B., "Improvements in obtaining colouring matters."

1529. Joseph Hamilton Beattie, Dowgate Hill, London, "Improvements in the means of preventing the formation of, and in the removal of, incrustations or deposits from steam-engine boilers."—A communication from Joseph Marks, Montreal, Canada.—Petitions recorded June 20, 1864.

Notices to Proceed.

460. Arthur Wall, Clapton, Middlesex, "An improved combination or improved combinations of combustible materials to be used as fuel."—Petition recorded February 24, 1864.

482. Alexander Prince, Trafalgar Square, Charing Cross, Middlesex, "Improvements in filtering apparatus."—A communication from François Michel and Aimé Pruvot, Paris, France.—Petition recorded February 26, 1864.

497. Frederic Weil, Paris, France, "Improvements in coating metals with one or several other metals, and in oxidising the surface of these latter."—Petition recorded February 29, 1864.

504. John Chapman, Albion Street, Hyde Park, Middlesex, "Spine-bags to be employed in controlling the circulation of the blood by the combined or independent application of ice or iced water and warm water or other fluid to the region of the spinal cord."—Petition recorded March 1, 1864.

528. Frédéric Pierre Langenard, Rue des Trois Couronnes, Paris, France, "Improvements in centrifugal machines for extracting juice of plants or drying up substances or materials of various kinds."—Petition recorded March 2, 1864.

770. Michael Henry, Fleet Street, London, "Improvements in apparatus for supplying air to persons employed under water, or in places where noxious gas, air, or vapour prevails."—A communication from Benoist Rouquayrol, Boulevard St. Martin, Paris, France.—Petition recorded March 28, 1864.

1486. Robert Whiteside, North Egremont, Cheshire, "Improvements in preserving iron ships and ships' sheathing from corrosion and fouling, and in apparatus to be employed therefor."—Petition recorded June 15, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, July 14, 1864.

THE Association for the advancement of astronomy and meteorology will give a grand *soirée* at the Observatoire on the 20th, which promises to be a very brilliant affair. This Society, which I have already alluded to as the thriving child of M. Leverrier, is making great progress in the provinces. At their first general meeting held a short time since a sum of 50,000 francs was voted for the construction of a telescope which will be placed in one of the provincial towns. As yet they have not determined which city is to be the fortunate recipient, but no doubt the one containing the greatest number of subscribers will have the best chance. They offer a prize of 4000 francs for the best treatise on telegraphic meteorology, and four annual prizes of 300 francs each for the best marine meteorological observations. Three prizes of 500 francs each to the authors of the best meteorological observations as affecting agriculture are also offered. The annual subscription is only ten francs, and ladies are eligible as members.

The Abbé Moigno gives his second lecture to-night on the Progress of Science during the past month, and to judge from the programme it will include a very large number of interesting subjects. I notice, however, that

the learned Abbé rather shirks chemical subjects, considering possibly that his hearers would not be able to stand much strong food at present.

The *Revue Maritime et Coloniale* has just discovered a mare's nest in the fact that the French artillerymen in Mexico found it necessary to alter the prescribed elevation of their guns for each range on account of the air of the Mexican high-level plains being rarer than that of their practice ground at Vincennes. The real wonder would be if it had not been so. The "Revue" claims for the French rifled cannon the merit of being the most perfect in the world in point of length of range and accuracy of flight. It is plain, however, that neither the editor nor the writer has ever seen a day's practice at Shoeburyness, or they might be induced to alter their opinion on this subject. The French rifled guns must do a great deal more than has yet been made public before they can attempt to compete either in size, range, accuracy, or destructive power with the weapons of Whitworth or Armstrong. The same journal gives a very full and fair account of Captain Palliser's invention of chilled cast-iron shot, and bestows so much praise on the gallant inventor that one cannot help pardoning the little performance on the trumpet I have just mentioned.

They have just discovered a well containing water at Pompeii, all the others hitherto found having been dry. A specimen of the water has been sent to Professor A. Lura for analysis, but I do not suppose its composition will differ much from that found in the same district at the present day.

M. L. Wilhelmy has lately published a series of observations on the capillarity of a large number of liquids, using in his experiments plates of pure platinum and copper. They seem to prove that there is no relation between the capillary co-efficients and the chemical composition of the bodies examined.

I hear that a company with a capital of 170,000,000 reals (about £17,000,000), has been formed in Spain for the purpose of carrying a telegraph across the Atlantic by a new route. Starting from Cadiz, it will touch at the Canary Islands, Cape Verde, at Fernando di Noronha, thence across the Atlantic to Brazil, and so on to French Guiana, the Antilles, Porto Rico, and Havanah, where a series of lines will join it with the North American continent. The longest submarine section will be only about 750 miles. The advantages both from an electrical and a commercial point of view of laying a long line in short sections is so well known to your readers that I will not enlarge upon it. A few days since I was in the company of one of the engineers lately employed in laying the Persian Gulf line, and, from what he told me, I fancy that we are just beginning to find out that we know little or nothing about the electrical anomalies that start up so continually in working a submarine line of any length.

Professor Tyndall attended the last meeting of the *Académie des Sciences*, and was welcomed with all that well-bred courtesy which French savans know so well how to show, but which they sometimes so unaccountably forget when they take a pen in their hands.

M. Deiss, one of the largest manufacturers of bisulphide of carbon in this country, has earned the gratitude of his workmen and neighbours by devising an apparatus, containing hydrate of lime, which effectually absorbs the waste sulphuretted hydrogen given off during the process. At the suggestion of M. Payen, M. Deiss has substituted for the lime, sesquioxide of iron mixed with sawdust. The products resulting are water and sulphur, the latter being recovered by simple washing with bisulphide of carbon and subsequent distillation. The oxide of iron is then calcined, and is once more ready for use. The idea has, of course, been taken from the method of gas purification now adopted by many companies, but the application is new, and MM. Payen and Deiss deserve great credit for carrying it out so successfully.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

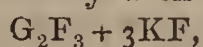
On the Employment of Fluohydrate of Fluoride of Potassium in Analysis, by WOLCOTT GIBBS, M.D., Rumford Professor in Harvard University.

THE facility with which the double fluoride of titanium and potassium separates in a crystalline state from hot aqueous solutions, on cooling, suggested to Wohler the best method at present known for obtaining pure titanitic acid. In Wohler's process, rutile or titaniferous iron is fused with an excess of carbonate of potash, the fused mass treated with water, which leaves the greater part of the iron undissolved, and the filtrate saturated with fluohydric acid. By re-crystallisation the fluotitanate $TiF_2 \cdot KF$, or, perhaps, more correctly, $Ti_2F_4 \cdot 2KF$ may be obtained in white scaly crystals, resembling boric acid; from this salt pure titanitic acid is easily obtained by precipitation with ammonia. Marignac modified this process very advantageously in the treatment of zircon to obtain pure zirconic acid. The zircon was fused with fluohydrate of fluoride of potassium directly. In this manner a perfect resolution of the mineral was easily obtained; the fluozirconate of potassium was then dissolved out from the insoluble fluosilicate by hot water, acidulated with fluohydric acid. The observations of Wohler and Marignac suggested to me a further extension of the same process, the general result of the investigation being that fluohydrate of fluoride of potassium or sodium may be employed with great advantage in resolving minerals containing metallic oxides of the types RO_2 and R_2O_3 . The special results are as follows:—

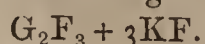
Glucinum.—Glucina, purified from iron and aluminium by the usual methods, is to be fused with twice its weight of fluohydrate of fluoride of potassium, and the fused mass treated with boiling water, to which a small quantity of fluohydric acid has been added. On filtering, a notable quantity of the insoluble fluoride of aluminium and potassium almost always remains upon the filter, even when the separation from glucinum has been carefully executed, by means of carbonate of ammonia. The filtrate on cooling deposits colourless transparent crusts of the double fluoride of glucinum and potassium, which are easily purified by recrystallisation. This method affords the simplest—I am almost disposed to say the only—method of obtaining a chemically-pure salt of glucinum. The double salt is apt to contain an excess of fluoride of potassium. To obtain it perfectly pure for analysis, Mr. J. C. Newbery fused the fluohydrate of potassium with an excess of glucina. The salt as thus obtained gave him:—

	Calculated.	Found.
Glucinum	5.74	5.70
Potassium	47.73	47.76
Fluorine	46.53	46.50
	100.00	99.96

which corresponds precisely with the formula—



if glucinum be taken as 7, or with $GF + KF$, if glucinum be taken as 4.66. In this analysis the fluorine was estimated by the loss. Berzelius gives the formula—



Glucina may be obtained directly from beryl, as Mr. Newbery* has found, by fusing the finely-pulverised

* Professor Jay had already remarked that beryl may be completely resolved by fusion with fluoride of potassium. See *American Journal of Science* for July, 1863.

mineral with fluohydrate of potassium, dissolving out the soluble double fluoride of glucinum and potassium, and purifying by re-crystallisation. As, however, beryl contains only 13 or 14 per cent. of glucinum, this process is not economical. It is better to separate the other oxides as far as possible by the ordinary methods, and then to purify the crude glucina by the process above pointed out. It is, perhaps, worthy of notice that while almost all proto- and sesquioxides give insoluble double salts, with fluoride of potassium, the fluoride of glucinum behaves like a bifluoride, so as to suggest that glucina may possibly be GO_2 instead of GO or G_2O_3 .

Ammonia precipitates glucina directly from the solution of the double fluoride. When a solution of fluoride of sodium is added to the one of aluminium and glucinum, the whole of the aluminium is thrown down in the form of cryolite, $Al_2F_3 \cdot 3NaF$, while the glucinum remains in solution. It is probable that this method will give accurate quantitative results.

Tinstone.—Mr. J. W. B. Hallett has found that tinstone is very easily resolved by fusion with three or four times its weight of fluohydrate of potassium. The mineral must be finely pulverised. The fused mass may be treated directly in the crucible with sulphuric acid to expel fluorine, after which, by adding water, filtering and boiling the filtrate, the whole of the tin may be thrown down as stannic acid, which is to be separated from traces of iron in the usual manner. This method of resolving the ore of tin is very much more convenient than fusion with caustic alkalies, or with sulphur and carbonate of soda.

(To be continued.)

On Fluoride of Thallium, by M. F. KUHLMANN.

LIQUID hydrofluoric acid attacks thallium with difficulty; in this respect thallium resembles lead. Its action on carbonate of thallium is more energetic, and by this means crystallised hydrated fluoride is obtained. Its crystals are white, some of the facets possessing a diamond-like brightness; they do not blacken by exposure to light; and from M. des Cloizeaux's optical examination, seem to originate from an oblique rhomboidal prism.

Fluoride of thallium can be entirely volatilised and transformed into a very bright satiny white crystalline mass, becoming black in the light, like chloride of silver; analysis has given for its composition the formula $TlFl$.

A solution of fluoride of thallium preserves an acid reaction even after several crystallisations of the fluoride. The crystallised salt has little stability; it decomposes slowly in the air, with disengagement of hydrofluoric acid, which attacks the glass. The solubility of fluoride of thallium establishes another analogy between this and alkaline metals; but this analogy becomes still greater and assumes a high scientific interest from the existence of a double fluoride of thallium and silicium, the composition of which is given in the formula $TlSiFl_2 + 2HO$, and which, treated by concentrated sulphuric acid, gives fluoride of silicium and hydrofluoric acid. This double fluoride is obtained by the action of hydrofluosilicic on carbonate of thallium. Fluoride of thallium and silicium, as well as simple fluoride, is very soluble in water; this solution has an acid reaction, and slowly deposits a little silica. Further, this compound attacks glass only after some length of time, and distils without decomposing. Its crystalline form belongs to the cubic system.—*Comptes Rendus*, lviii, 1037.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

LEATHER.—The art of the currier. Morocco, Russia, and patent leathers. The art of tawing skins. Chamois and glove skins. Parchment. Hair, its composition and dyeing. Wool, its washing, scouring, bleaching, and dyeing. Silk, its adulterations and conditioning.

LECTURE III.

DELIVERED ON THURSDAY EVENING, APRIL 14, 1864.

I shall have to crave the indulgence and patience of my audience during this lecture, as it will chiefly consist of descriptions of processes for the most part well known to manufacturers and others engaged in the leather trade. Thus the art of currying, which is applied principally to such leathers as are intended for the upper parts of shoes, for harness, &c., is carried on at the present day nearly as it was fifty years ago, and still is but little known to the public.

Currying.—The objects in view in currying leather are several: to give it elasticity—to render it nearly impermeable—to impart to it a black or other colour, and, lastly, to reduce it to uniform thickness. These qualities are imparted by the following processes:—After the leather obtained from hides or the thicker qualities of skins has been damped, it is placed on a stone surface and energetically rubbed—first with a stone, then with a special kind of knife called a slicker, and lastly with a hard brush. The leather is then ready to be stuffed or dubbed, which consists in covering it on the fleshy side with tallow, and hanging it in a moderately warm room; and as the water contained in the leather evaporates, the fatty matter penetrates into the substance of the leather and replaces it. The dubbing process is then repeated on the other side of the leather, which is now ready to be softened and rendered flexible, which is effected by rubbing it with a tool called a pummel. The leather then undergoes the last mechanical operation, which reduces it to uniformity of thickness by shaving off the inequalities of its surface by means of a peculiarly shaped knife called a slicker. The greatest part of the curried leather is blackened on the grain side by rubbing it with grease and lamp black, and lastly brushing it over with a mixture of grease and glue. I believe that some kinds of curried leather are dyed by a purely chemical process, in rubbing the tanned skin, first with iron liquor, and then with a solution of gall nuts or other tanning substance. The most tedious of the foregoing processes is that of dubbing, which has been greatly improved of late years by the Americans. The scoured skins are placed in a large revolving drum, of ten or twelve feet diameter, and lined inside with wooden pegs. A certain quantity of tallow is then introduced and the whole set in motion, and whilst the hides are thus tossed about, a current of warm air is passed through the drums, which carries off the moisture and allows the grease to penetrate the hide. By this means thick hide leather can be stuffed in four or five days.

Split Leather.—A large branch of trade has sprung up within a few years owing to the invention of machinery for splitting hides, skins, and kips, by which, although the quantity of leather has been considerably increased, I am afraid it is at the expense of its quality.

Fancy Leathers.—Allow me now to give you a slight insight into the methods of preparing various fancy leathers, such as Morocco, Russia enamelled, tawed, or kid leather, used for soldiers' belts, gloves, &c., and, lastly, oiled leathers, used for washleather, gloves, &c. Until the middle of the eighteenth century Morocco leather was wholly imported from that country, for it was in 1735 that the first Morocco works were established in Paris, and similar manufactories were soon set up in various parts of the Continent and in this country. The process by which

Morocco leather is prepared is as follows:—The goat and sheep skins, which are especially used for this branch of manufacture, are softened, fleshed, unhaired, and raised or swelled by methods similar to those already described, but one essential element of success in this kind of leather lies in the perfect removal of all lime from the skins, which is effected by plunging the well-washed skins in a bath of bran or rye flour, which has been allowed to enter into a state of fermentation. The result is, that the lactic and acetic acids generated by fermentation of the amylaceous substances combine with the lime and remove it from the skins. The other essential point is the mode of tanning the skins. Each skin is sewn so as to form a bag, and filled, through a small opening, with a strong decoction of sumac, and after the aperture has been closed the skins are thrown into a large vat containing also a decoction of the same material. After several hours they are taken out, emptied, and the operation is repeated. To render these skins ready for commerce it is necessary to wash, clean, and dye them. The latter operation was formerly tedious, and required great skill, but since the introduction of tar colours, the affinity of which for animal matters is so great, it has become comparatively easy. The skins, after they are dyed, are oiled, slightly curried, and the peculiar grain, characteristic of Morocco leather, is imparted to it by means of grooved balls or rollers. There are two inferior kinds of Morocco leather manufactured, viz., those called *roan*, prepared in a similar way to Morocco, but not grained, and *skivers*, also prepared in the same manner, but from split sheep skins. I owe to the kindness of Mr. Warren De la Rue the beautiful specimens of leather before me, which will enable you to appreciate the various qualities of these interesting productions.

Russia Leather.—The great esteem in which this leather is held is owing to its extreme softness and strength, its impermeability, and resistance to mildew, which latter property is imparted to it by the use of a peculiar oil in its currying, that is birch-tree oil, the odour of which is well-known as a distinguishing feature of Russia leather. As to its preparation I will merely state that it is very similar to that of Morocco, with these differences, that hot solutions of willow bark are used instead of sumac; that it is generally dyed with sandal wood and a decoction of alum; and, lastly, as already stated, the birch-tree oil is used in currying it.

Enamel Leather.—This class of leather is usually prepared with calf and sheep skins tanned in the ordinary manner. They are dyed black by rubbing them over with a decoction of logwood, and then iron liquor or acetate of iron. The leather is softened with a little oil, and is ready to receive a varnish, which is applied by means of a brush, and composed of bitumen of Judea, copal varnish, oil varnish, turpentine, and boiled oil.

Tawed or Kid Leathers.—The manufacture of this class of leathers differs entirely from those already described, as their preservative qualities are imparted by quite different substances from those used with other leathers, the preservative action of the tannin being substituted by that of a mixture of alum and common salt. Let us examine together a few points connected with the production of this class of leather. One of the most interesting characteristics is the method of unhairing sheep, lamb, and kid skins, after they have been well washed and fleshed on the beam. The old process of unhairing by smearing on the fleshy side with a milk of lime, was improved by mixing with the lime a certain amount of orpiment, or sulphuret of arsenic, but Mr. Robert Warrington having ascertained that the rapid removal of hair in this case was not due to the arsenic, but to the formation of sulphuret of calcium, proposed, with great foresight, the following mixture as a substitute for the dangerous and poisonous substance called orpiment—viz., three parts of polysulphuret of sodium, ten parts of slacked lime, and ten parts

of starch. The polysulphuret of sodium may be advantageously replaced by the polysulphuret of calcium. The skins, unhaired by any of these processes, are now ready to be placed in a bran or rye bath, as with Morocco leather, or in a weak solution of vitriol, to remove, as already stated, the lime. After the lime has been thoroughly removed from the skins, they are dipped in what is called the white bath, which is composed, for 100 skins, of 13 to 20 lbs. of alum, and 4 to 5 lbs. of chloride of sodium or common salt, and the skins are either worked slowly in this bath or introduced into a revolving cylinder to facilitate the penetration of the preservative agent, which, according to Berzelius, is chloride of aluminium resulting from the action of the chloride of sodium on the alum. When the manufacturer judges that the skins have been sufficiently impregnated with the above mixture, he introduces them into a bath composed of alum and salt in the same proportions, but to which is added 20 lbs. of rye flour and 50 eggs for 100 skins. After remaining a few hours they are removed, and allowed to dry for about fifteen days, and are then softened by working them with a peculiar iron tool, and the white surface which characterises that class of leather is communicated to them by stretching them on a frame and rubbing them with pumice-stone. A large quantity of tawed leathers are also preserved retaining their hair, which is done by simply suppressing the unhairing and rubbing processes.

Chamois, Wash, or Oiled Leather.—This class of leathers are named from the fact that formerly they were exclusively produced from the skin of the chamois, but at the present day sheep, calf, and deer skins, and even split thin hides, are manufactured into this kind of leather. I should also state that the employment of this kind of leather has greatly decreased of late years, owing to the general substitution of woollen fabrics in articles of clothing. You will see by the following description that the preparation of this class of leather differs entirely from those previously detailed; the conversion of skins into leather, or from a substance subject to putrefaction to one free from that liability, being no longer effected by tannin, as in the case of hides, and Morocco and Russia leathers, or by the use of mineral salts, as in the case of tawed leathers, but by that of fatty matters, especially animal oils, such as sperm. The skins are prepared in the same manner as for tawed leathers, and then submitted to what is called the prizing operation, which consists in rubbing the hair side of the skin with pumice stone and a blunt tool or knife, until the whole of the rough appearance is removed, and the skin has acquired a uniform thickness. They are then worked on the peg until the great excess of moisture has been wrung out, and plunged into the trough of a fulling mill, to the action of the wooden hammers of which they are subjected until nearly dry. They are then placed on a table and oiled, and several of them, after being rolled together, are replaced in the trough of the fulling mill. When the oil has been thus worked into the substance of the skins, they are removed, exposed to the atmosphere, again oiled, and once more subjected to the fulling mill; after which they are placed in a moderately heated room for a day or two, the object of which is twofold, viz., to facilitate the evaporation of the water and the penetration of the oil, and to create a slight fermentation, by which the composition of certain of the organic substances have undergone such modification as to enable them to combine in a permanent manner with the fatty matters. These processes are repeated until the manufacturer deems the leather sufficiently prepared to be fit to undergo the following operations, viz., to be immersed for several hours in a caustic lye bath, to remove the excess of oily matter, washed, and pegged. It is only necessary to stretch the leather on a table, then on a horse, and lastly between rollers, after which it is ready for the market. The ordinary buff colour of these leathers is communicated by

dipping them, previously to the finishing processes, into a weak solution of sumac. Before speaking of the further processes necessary to fit these leathers for the glove manufacturer, allow me to have the pleasure of describing that of Mr. C. A. Preller, whose mode of preparing leather is very interesting, owing to the rapidity with which he converts hides into leather, and also to the remarkable toughness which his leather possesses. To attain these desirable ends Mr. Preller proceeds as follows:—The hides are washed, slightly limed, unhaired, fleshed, and partially dried; they are then smeared with a mixture made of fatty matters and rye flour, which having been prepared a few days previously has entered into fermentation, and which has so modified the fatty matters as to render them more susceptible of immediate absorption by the hide. I think that this feature of Mr. Preller's plan deserves the serious notice of all engaged in the manufacture of oiled leathers, as it appears to prove that fatty acids (or modified fatty matters) are better suited for combination with skins than neutral fats. The hides, with additional fatty matters, are then introduced into the large American drums, previously noticed in speaking of currying, and after four days they are removed, washed in an alkaline fluid, worked with a pummel and slicker, and after being dried they are ready for market.

Gloves.—The manufacture of this article is now a most important branch of trade, and is the means of giving employment to large numbers of people in several towns in this country as well as on the Continent. To render the above-mentioned oiled leather sufficiently soft and pliable for gloves it is necessary to submit it to the following further operations:—The Chamois, kid, or other skins are rubbed over with a solution composed of 1 lb. of soap, dissolved in half a gallon of water, to which is added 1½ lb. of rapeseed oil and twenty yolks of eggs, or, what has been recently found to answer better than eggs, a quantity of the brains of animals reduced to pulp. The use of the two latter substances is extremely interesting in a scientific point of view, for they both contain a peculiar nitrogenated matter called vitalline, and special fatty matters called oleophosphoric and phosphoglyceric acids, which doubtless, by their peculiar composition, communicate to the skins those properties which characterise this class of leather. The skins are then washed and dyed in various colours, after which they are softened, and rubbed with an instrument adapted to slightly raise the surface, and give it that well-known velvety appearance belonging to glove skins. I shall not take up your time by entering into the details of dyeing these leathers, but describe the following process for bleaching them:—

Bleaching of Skins.—The only process known until recently for imperfectly bleaching chamois and glove skins was that of submitting them to the influence of the fumes of sulphur in combustion or sulphurous acid, but latterly two modes of attaining that object have been proposed. The first consists in dipping skins for two days in a weak solution of neutral hypochlorite of soda, washing, drying, and rubbing them with soap and oil. The second mode is to dip glove skins into a solution of permanganate of potash, when they soon assume a brownish colour, due to the liberation of the oxygen of the permanganate of potash, and the fixation of the hydrate of sesquioxide of manganese by the skin. The skins so acted on are washed and then dipped in a solution of sulphurous acid, which becomes converted into sulphuric acid by the action of the oxygen of the sesquioxide of manganese, and the protoxide thus produced unites with the sulphuric acid, which is soluble in water. The skins thus bleached when dressed are ready for market.

Gilding of Leather.—The usual mode of ornamenting leather with gold is to apply, in such parts as are desired, a thick solution of albumen, covering those parts with gold leaf, and applying a hot iron, when the albumen is

coagulated and fixes the gold. This plan is objectionable when the goods are intended for shipment, and the following method, lately proposed, is far preferable:—On the parts required to be gilt, a mixture, composed of five parts of copal and one of mastic, are spread; a gentle heat is applied, and when the resins are melted the gold leaf is spread upon them.

Parchment.—There are two distinct qualities of this valuable material, which has been used from time immemorial as a means of preserving records. The best quality is prepared from young lamb, kid, and goat skins, and the second quality from calf, wolf, ass, and sheep skins. To make parchment, the following is the process:—The skins are stretched on strong rectangular frames, limed, unhaired, fleshed very carefully, and rubbed with pumice stone until the skins have acquired the proper thickness. They are then dried very carefully in the shade.

Dialysis.—Thomas Graham, Esq., Master of the Mint, has lately drawn the attention of the scientific world to a most remarkable property possessed by organic membranes of separating, when in solution, crystallisable bodies from those which are not so. The former he names crystalloids, and the latter colloids. For instance, if a solution of sugar (crystalloid) is mixed with one of gum (colloid) and placed in the vessel, the bottom of which consists of a septum of animal or vegetable parchment, the crystalloid sugar will pass through the membrane into the surrounding water, whilst the colloid gum will remain in the vessel. Again, if solutions of iodide of potassium and albumen be mixed together, the iodide of potassium will diffuse itself through the membrane, which the albumen will not do. Also, if to an alkaline solution of silicate of soda weak hydrochloric acid be cautiously added, chloride of sodium will be produced, and silica will remain in solution; and if such a solution be placed in the dialyser, the chloride of sodium (the crystalloid) will diffuse itself through the membrane, while the silica (the colloid) will remain behind. It is impossible to calculate the immense service which the discovery of these facts by Mr. Graham will render to physiology, toxicology, or to manufactures, as, in fact, every day new applications of it are being made in these various departments of human research. Thus, to give an example which has special reference to these lectures, I have lately seen it proposed by Mr. A. Whitlaw to place salted meat in large dialysers, when it is stated that the salt only will be removed, leaving all the nutritive properties of the meat undiminished. Mr. Whitlaw also proposes to dialyse the brine in which meat has been salted, and thus to remove the salt, leaving the juice of the meat available for use, while the salt is again in condition to be employed as before.

It will now be my agreeable duty to examine with you a few facts relating to hair and wool. It is interesting to observe that hair, wool, feathers, nails, and claws may be all considered as prolongations of the epidermis, and present nearly the same chemical composition, as will be seen by the following table:—

	Epidermis of Man.	Hide.	Man's nails.	Hair.	Quill.	Horse's hoof.	Scale of reptile.
Carbon	50.89	50.89	51.09	50.14	52.43	50.40	53.60
Hydrogen	6.81	6.78	6.12	6.67	7.22	7.00	7.20
Nitrogen	17.22	17.25	16.91	17.94	17.93	16.70	16.30
Oxygen and Sulphur ..	25.63	25.08	25.88	25.25	22.42	25.90	22.90
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

These substances have also this peculiarity, that, notwithstanding their great richness in organic matters, they are extremely slow to decompose.

Hair.—The only real point of interest connected with hair appears to me to be the question as to what its various colours are to be ascribed, and I regret that here I can

only give conjectures and not positive facts. Vauquelin and Fourcroy, who analysed hair most carefully half a century ago, stated that hairs were hollow cylindrical tubes filled with oils of various colours; but Gmelin and others state that the coloration of hairs is due to the different proportions of sulphur that they contain.

QUANTITY OF SULPHUR IN HAIR.

Brown	4.98
Black	4.85
Red	5.02
Grey	4.03

Recently Mr. Barreswil has published a paper, in which he states that the coloration of hairs is probably due to the proportion of iron in their composition, and he argues that as iron is the essential element of the colouring matter of blood, it is highly probable that it fulfils the same office with respect to hair. I may state, *en passant*, that also great improvements have lately been made in dyeing human hair. Formerly the patient had to undergo most unpleasant treatment, his head being covered with a paste consisting of three parts of lime and one of litharge. An oil cap was then applied and the patient left for twelve hours, when the disagreeable operation of removing the mass and clearing the hair was proceeded with. The black dye communicated to the hair in this process was due to the sulphur of the hair combining with the lead of litharge, and forming black sulphuret of lead. The present process consists in cleaning the hair thoroughly with a strong alkaline soap, or a little weak alkali, then carefully applying a solution of nitrate of silver, and lastly a solution of monosulphuret of sodium.

Wool differs from hair chiefly by its property of felting, which it owes to its numerous cross lines or serratures, as they are termed; the finer the wool the greater the number of its serratures. Thus, whilst Mr. Goss has found in the finest Saxony wool 2720 of these serratures in a single inch in length, he only found 2080 in an inch of South Down wool, and 1850 in Leicester. The wool of sheep can be classed under two heads, that is, into long wool and short wool. Certain classes of sheep will maintain the type or quality of their wool under every circumstance. Such are the original types of South Down, Norfolk, and Dorset, all of which are short wool, and all these sheep feed upon fine and short grass. It has been observed that if they are fed upon coarse grass, their wool will also become coarse. This is also true with Welsh, Scotch, and even Spanish merinos. A further proof that this view appears correct is, that the long-wool sheep, such as those of Leicester, Lincoln, and Kent, feed in valleys where grass is long and coarse. In all cases the size of the animal appears also to correspond with their class of food. Another curious fact is the facility with which one type of sheep will merge into another if they change food and climate. Thus many attempts have been made to introduce into France our Leicester breed, the wool of which is so remarkable for its fineness, length, and silvery appearance. Still, after four or five years' residence there, the wool has lost its most valuable qualities. In fact, they are no more the Leicester breed. The coarse wool of sheep, however, such as those of Devonshire, does not appear to be so rapidly influenced by any change of climate which the animal may undergo. The aptitude which various kinds of wool have for dyes is also interesting. Thus the wool of one kind of sheep will not dye with the same facility as that of another; and wool dyes much more uniformly, if the animal has been washed before shearing than when the washing is performed upon the wool afterwards. Lastly, the wool removed by the liming process before described will be far inferior in dyeing properties to wool taken from the same kind of animal during life. It may be interesting to some present to know the best method of removing these irregularities. I was engaged during my assistantship at the Gobelins in

investigating this matter, and I found that the best plan was to steep the wool for twenty-four hours in lime water, and then to pass them through weak hydrochloric acid. Wool, as it leaves the animal, is not fit for either dyeing or spinning. Thus, when wool is washed with water, it yields a large quantity and variety of substances, which in France bear the name of *suint*. The most interesting fact connected with this is, that the 15 per cent. yielded by wool does not contain, as shown by M. Chevreul, any salts of soda, but a large quantity of salts of potash, the greatest part of which is combined with an acid called sudoric; and what increases the interest of this fact is that Messrs. Maumené and Rogelet displayed at the last Exhibition salts of potash which they had obtained commercially from this new source. In fact, they have established in several of the large manufacturing centres of France, where considerable quantities of wool are used, factories for the extraction of salts of potash from the *suint*, and they supplied the jury with the following particulars:—That a fleece of wool weighing 8 lbs. yielded on the average about $1\frac{1}{4}$ lb. of dry *suint*, or sudorate of potash, and this would further yield about seven ounces of pure potash. If it is now considered that there is annually twenty million pounds of wool washed in Rheims, thirty millions at Elbeuf, and four millions at Fourmies, it would appear from this quantity that if it were all subjected to Messrs. Maumené and Rogelet's treatment, about $2\frac{1}{4}$ million pounds of pure potash might be recoverable. For further details on this point see Dr. Hofmann's report on chemical products and processes in the last Exhibition. Wool which has been simply washed, as above described, is not sufficiently free from extraneous matters to be fit for application in manufactures. It is necessary that it should be scoured, for which purpose, on the Continent, it is allowed to remain for some time in putrid urine, or weak ammoniacal liquor, but in this country it is placed in strong alkaline soap or soft soap, passed through rollers to press out the excess of soap, together with the impurities which it removes, well washed, and dried. In these operations wool loses in weight above 50 per cent. when of good quality, and above 30 per cent. when inferior. But even then the wool still retains a certain amount of fatty matters, which it yields to hot alcohol.

The following table, published by M. Chevreul, will give you an idea of the composition of wool dried (at 212°):—

Earthy matters	27.40
Organic and inorganic salts, soluble in water (<i>suint</i>)	32.74
Fatty matters	8.37
Wool	31.49
	<hr/>
	100.000

Elementary composition, C. 50.66, H. 7.03, N. 17.74, O. 22.32, S. 2.25.

Before proceeding further, I should like to call your attention to the curious fact that the fatty matters of wool are completely different from the fatty matters of the animal itself; thus, whilst the ordinary suet will be saponified by an alkali, the fat of the wool will not undergo that change, the stearine and elearine being only converted into an emulsion. From experiments I have made I am able to state that the common opinion that the differences in quality observed in various wools are owing to their fatty matters is erroneous, as the pure wool obtained as above yielded to the dyer colours as brilliant as those presented by wools in which a part of the fatty matter still remained. Another important fact connected with the composition of wool is the quantity of sulphur it contains, which does not appear to be part of the fibre, as the matter containing it can be removed by a weak alkali without destroying the fibrous appearance of the wool, although its tenacity is greatly impaired, and its power of taking dye considerably diminished. Another remarkable fact is that when wool is bleached by sulphurous acid, the

only agent known which will effect that purpose, it becomes incapable of taking many colours, especially the new and brilliant coal tar dyes. The long-disputed question among chemists—how sulphurous acid operates so as to bleach wool?—has lately been solved by Messrs. Leuchs and Weber, who have proved that sulphurous acid unites with the colouring matter of the wool, forming a colourless compound, in proof of which it appears that if the wool is placed in boiling water this colourless compound is dissolved, and the wool regains its susceptibility to dyes, though it is slightly discoloured. A slight amount of alkali added to the boiling water greatly facilitates the removal of this artificial sulphuretted compound. In a paper lately published by Mr. Grothe, he states that 100 parts of wool fix, on an average, 0.67 of sulphur, or 1.31 of sulphurous acid to bleach it, and, practically, 100 parts of wool require about 5 parts sulphur to be burnt to produce the result. I should also state that wool must always be wet before being submitted to the fumes of sulphur, and it is always advantageous to pass it previously through a soap lye or weak alkali. Wool so bleached should always be well washed in cold water to remove the excess of sulphurous acid, which otherwise, if the wool were subsequently exposed to moisture, might be converted into sulphuric acid, and destroy the fibre of the wool. It may be interesting to ladies to know the process used by a French scourer, named Jolly, to restore Cashmere shawls discoloured by time. It consists in dipping them into a solution of sulphurous acid, which bleaches the wool, but does not affect the fast colours with which the fibres composing the patterns of the shawls are dyed. The shawls then only require to be washed and pressed to be restored to their original beauty. There is no doubt in my mind that a solution of sulphurous acid might be substituted for the gas in bleaching wool with advantage and economy, owing to the sulphurous acid being in a more condensed form, and in better condition for effecting the bleaching process. A few years ago I took advantage of the fact that wool contains sulphur to produce upon it an artificial lustre. The woollen goods were passed through a weak boiling solution of acetate of lead, washed carefully in pure water, and submitted to the action of high-pressure steam, when the lead combined with the sulphur of the wool, producing galena, which gave the wool a lustre. The action was regulated by generating, under the influence of steam, nascent sulphuretted hydrogen from a polysulphuret of sodium, which facilitated the object in view. Wool is generally dyed either in the fleece, after undergoing the processes of washing and scouring, or it is first spun into yarn or worsted. To describe all the various methods of dyeing wool would far exceed the limits of this lecture. The operations of spinning wool into yarn or worsted are purely mechanical, and it is not therefore within my province to describe them. The same remark applies also to the manufacture of felt and shoddy, now so extensively carried on in Yorkshire, and I shall therefore merely refer to one or two points having reference to chemistry, such, for instance, as the working up of the wool or the cotton in worn-out fabrics. To recover the wool from such fabrics the process is most simple, consisting simply in immersing them in diluted muriatic acid, and drying them at a temperature of about 220° , by which means the cotton is completely destroyed, the wool remaining unaffected. The material is then submitted to the action of a "devil," which separates and blows away the cotton, leaving the wool ready for being worked up. To remove the vegetable fibre with the view of applying it to the purposes for which it is adapted,—as the paper manufacture, for instance,—the following process has been devised by Mr. F. O. Ward and Captain Wynants. The mixed fabric is submitted to high pressure steam (60 to 80 lbs. to the square inch), and under the influence of this high and moist temperature the vegetable fibre remains unchanged, whilst the

animal one is so much disorganised that when the rags are removed from the receptacle and dried, and submitted to the action of a beating machine, the cotton fibre remains intact, whilst the animal matter falls to the bottom of the machine in the form of a dark-coloured powder mixed with small lumps of the same substance; this residue has been advantageously applied as a manure, by these gentlemen, under the name of "ultimate of ammonia." I am happy to state that chemical science has discovered several means of distinguishing cotton from wool when employed in the same fabric, and even of determining their respective weights in the same; but the aid of the magnifying powers of the microscope is often required in investigating the mixtures of wool with flax, cotton, jute, &c., which are now so extensively and so ingeniously spun together. The description of these processes, however, would involve so much technicality, and require so much time, that I must not trouble you with their details. The same remarks apply to the means used for distinguishing the materials used in mixed fabrics of silk and cotton, or silk, wool, and cotton.

Silk.—This material has always been highly esteemed, owing to its remarkable durability, and to the beauty of the fabrics produced from it. Thus, the Chinese have used silk from time immemorial, and the Romans held it in such high estimation that, at the time of the Cæsars, silk was worth its weight in gold. The most interesting fact for us is the date of the introduction of the silkworm into Europe; it is related that in A.D. 555 two monks, returning from the East, concealed some silkworms' eggs in their staves, and having succeeded in rearing the worms, their culture soon spread through Greece and Turkey, and gradually found its way into Italy towards the twelfth century. The silk in use at the present day is chiefly derived from the *Bombyx mori*, but the extensive disease which has during the last eight or ten years destroyed very large numbers of the worms, has given rise to great efforts to introduce some new species, two of which, the *Bombyx mylitta*, feeding on the *Palma christi* or castor-oil tree, and the *Bombyx alianthus*, feeding on the plant from which it is named, have been to some extent successful. The material forming the silk is secreted in two glands placed on the side of the animal's body, whence it passes into an organ called the spinaret, on each side of which are two other glands, which secrete a gummy substance, and this uniting with the former forms the silk fibre. Permit me to add here a fact which I think will interest you—viz., the extraordinary weight of silk which a small weight of eggs will yield. Thus, four ounces of eggs will yield 87,900 to 117,000 cocoons; and as, on an average, a pound of silk requires 270 cocoons, the four ounces of eggs will give 422 lbs. of silk, or 100 lbs. of cocoons yield generally 8 lbs., or about 14 per cent. of silk. The production of silk fibre from cocoons is extremely simple. It is effected by placing the cocoons in boiling water, which softens or dissolves the gummy matter which binds the fibres together, and the end of the fibre being detached and placed on a reel, is easily wound. This is the state in which it is usually imported into this country under the name of raw silk. When two or more of these fibres are slightly twisted together they form what it is called tram or weft, and when two of the threads are twisted in opposite directions and laid together they form organzine or warp. To render this substance susceptible of dyeing, it is necessary to remove the gum by an operation called boiling off, which consists simply in boiling the silk for some time in a soap lye, and washing and wringing it well afterwards, in which operation it loses about 21 per cent. The following table will show the chemical composition of silk:—

Gelatine	19.08	} Commercial yield, 79 per cent. of silk.
Albumen	25.47	
Wax and fatty substances	1.45	
Silk fibre	54.00	
—100.00		

FIBROINE.

Carbon, 48.53; hydrogen, 6.50; nitrogen, 17.35; oxygen and sulphur, 27.62.

Conditioning Silk.—This expression implies the ascertaining of the real commercial value of silk, or, in other words, its condition, and the necessity of this has been so fully admitted that a conditioning house has existed for 40 or 50 years in Lyons, and its advantages have been so fully appreciated that similar establishments have arisen and are well supported in every town on the Continent, where dealings in silk to any amount take place. I may mention, as an instance of the universal adoption of the practice, that even in Crefeld the finest building in the town is the conditioning house. The result is that on the Continent the intervention of the conditioning house between buyer and seller has become quite a matter of course, with the happy result of abolishing a class of dishonourable dealing which is eating like a canker into the silk trade of Great Britain. I cannot understand why the attempts made to introduce this admirable system into our country have hitherto met with so little success, and can only infer that there is an unsoundness in the trade, which places many of the silk manufacturers to a great extent under the control of wealthy merchants, who, it appears, are the chief opponents of conditioning. Otherwise one would suppose that its advantages to all engaged in working up this valuable product are too obvious to require demonstration, for, taking the most lenient view of the matter, the average gain to the manufacturer by conditioning will be not less than five per cent., and this loss (if he does not condition) cannot be recovered in any subsequent stage, so that his foreign competitor has in this respect alone an advantage over him of at least five per cent. Allow me to conclude this lecture by stating in a few words how conditioning is carried on. Silk being an exceedingly hygrometric substance—its moisture varying constantly with the amount of humidity and the temperature of the atmosphere—the first operation is to ascertain the total amount of water it contains, for which purpose samples, carefully selected from the bale when it reaches the conditioning house, are weighed in delicate scales, dried in hot-air stoves, and re-weighed, the excess of moisture (beyond the 10 per cent. admitted to be the average normal quantity) being then easily calculated. The second operation carried out in the conditioning house is that of boiling off the samples dried as above, and again drying and reweighing, to ascertain the quantity of soap, oil, sugar, acetate of lead, &c., added to give weight, and the result of this operation is to show a loss of 30, 35, and even 40 per cent. instead of about 21 per cent., which is the average amount of natural gum.

ACADEMY OF SCIENCES.

July 11.

M. ROBINET communicated the second part of his "*Memoir on the Estimation and Analysis of the Gases in Potable Waters*," but a short abstract only, from which we can extract no useful information, is given in the *Comptes-Rendus*.

A paper on "*Hexylic Glycol*" was presented by M. Wurtz; and another, on "*Octylic Glycol*," by M. de Clermont. Hexylic glycol M. Wurtz has decided to be isomeric with dihydrate of diallyl. Both these glycols, we may say, were obtained by the general process described for the preparation of those bodies.

M. V. de Luynes presented a note "*On the Part which Erythrite Plays in the Immediate Principles of Certain Lichens*." The author considers the constitution of erythrine as analogous to that of the compound ethers (of fatty bodies, for example), and considers that erythrite pre-exists there, just as glycerine exists in fatty bodies.

M. Maumené communicated a note "*On Bichloroacetic Acid*," which he forms by placing monochloroacetic acid

in contact with dry chlorine gas. The reaction is finished in twenty-four hours, and then it is only necessary to drive off the hydrochloric acid over a water bath, after which the bichloroacetic acid is left pure. The author describes the silver salt, and the results of its analysis.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. PERCY, F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.

LECTURE XI.—Thursday, January 28.

(Continued from page 22.)

We proceed next to a subject of the very highest interest to geologists, and one which of late has excited great attention. I allude to that of metamorphism.

In the glossary of the "Principles" of Sir Charles Lyell, metamorphic rocks are defined to be—(these are his words)—"a stratified division of hypogene rocks, highly crystalline, such as gneiss and mica schist, and so named because they have been altered by plutonic action." By "hypogene" Sir Charles Lyell means what he terms "netherform"—from below. This definition, I should state, is found in the "Principles" published in 1853. I have not referred to see whether it has been altered in subsequent editions. I venture to submit that this definition is limited in its scope, and not very precise in its construction. The last clause—"they have been altered by plutonic action," or, in plain English, "they have been changed by heat"—might mean that the rocks referred to were originally the direct result of "plutonic action," and had undergone a further change by heat while in their present position. The introduction of the words, "subsequent to their deposition," after the word "because," would make the author's meaning clear. The definition is limited in its scope, as it excludes from consideration every change in strata of sedimentary origin which does not proceed from the operation of heat alone. We shall see, by-and-by, numerous examples of metamorphism where plutonic action has had nothing to do with it. The term "metamorphism" should have a much wider acceptance, and embrace all the changes in the chemical and physical characters of sedimentary and all other rocks, caused either by thermal action—by the operation of chemical forces within the mass, or by the chemical action of other matter from without, whether gaseous or liquid. I will explain these points in the course of the present lecture.

The subject of metamorphism, I say, is one of the highest geological interest, and although several able and original observers have specially directed their attention to it, yet, like so many other fields in nearly every department of science, it is as yet comparatively unexplored. It requires both chemical and geological knowledge to investigate it successfully. These two sciences must go hand in hand. To communicate what is known on the subject would occupy several lectures, and, therefore, on the present occasion, I shall endeavour to present you with a classification of what has been actually established, or may, I think, be fairly deduced.

The first phase of the subject of which I shall speak is metamorphism by heat alone, without loss of matter. One of the simplest conceivable cases of this kind is the deposition of silica in the form of sand, its consolidation into sandstone, and the prismatic or columnar structure communicated to this sandstone by the operation of heat alone, exactly similar to what we see occurring in our blast furnaces. I have placed before you illustrative specimens from blast furnaces. This was a piece of common sandstone. It was there exposed for a long time—it may have been for several years—to a high temperature. You observe for yourselves the change which it has undergone. It has become columnar, breaking into small pieces, and remind-

ing one of basaltic columns in miniature. This has taken place by the operation of heat alone. There is another curious specimen from the hearth of a blast furnace, showing the transformation of sandstone into something apparently quite different. This is a piece of the sandstone in its original state, grit stone, unmistakably. There is a piece of the same sandstone after exposure to a long continued heat during some years. No metamorphism can be more complete than that. There are, in addition, certain points of interest in this particular specimen. You may ask, "Are you quite sure the change is due to heat alone?"—a very proper question to put; and I regret that I cannot give you a very satisfactory and perfectly certain answer. It is just possible that certain alkaline vapours produced by the blast furnace may have acted upon it; but that is mere conjecture. It contains minute particles of metallic iron disseminated through the mass; and altogether it is one of the most singular and interesting specimens illustrative of metamorphic action by heat that I have met with in the course of many years' search. I call your attention especially to those two specimens—the one the original sandstone, and the other the metamorphosed stone. Here is another specimen, from Norway, which I received many years ago from Mr. David Forbes. It is a mica schist which had been exposed to a long continued heat in a blast furnace there. You will see that it has undergone considerable alteration in structure, or the original structure has become very much developed and more conspicuous. We have, then, a supposed conversion of amorphous carbonate of lime into saccharoidal limestone by heat alone. I may mention an observation by Darwin, at St. Jago, Cape de Verde Islands. He says that a stream of lava overflowed Muschelkalk, which, for several inches from the line of contact, was converted into beautifully crystallised marble. We have already discussed this point on a former occasion.

Then there is a metamorphism due to a rearrangement of particles, forming new chemical compounds. This is a grand object of inquiry, but one which, as yet, is extremely imperfectly investigated. I may mention as an example the transformation of clay slate into that stratified rock called gneiss. The transition in some cases is found to be most gradual. I would mention the result simply of Carius's analyses of six different specimens from Löhen, in Saxony, illustrating the gradual passage of clay slate into gneiss—clay slate distinct at the one end, and gneiss at the other. He did not succeed in detecting any appreciable difference in ultimate chemical constitution. I mean by that, that the specimens all contained the same percentage of silica, lime, and so on, though the particles were arranged differently in all the different specimens. In Switzerland, in the Churwalden Thal, is a bed of gneiss between two beds of fossiliferous slate. The slate is everywhere unchanged, both above and below; and the lower bed is of great thickness, thus proving that the gneiss could not have been heated from below, or to any great extent. That would give us reason to believe that gneiss has been the result of what I would call "thermo-hydric action," of which I will speak more by-and-by.

Then there is a metamorphism which takes place with loss of matter. An instance of this exists in the dehydration of silicate of alumina, as in the conversion of argillaceous deposits into slate. Then I might refer to porcelain jasper, which is nothing more than a variety of clay which has been heated for a long time. Occasionally, we meet with specimens of this on coal-pit mounds which have been spontaneously ignited, and where the carbonaceous shale has been slowly burning for many years. There is a well-known locality—Fieryholes, near Dudley,—where you will meet with magnificent specimens of this. You will sometimes find a fragment consisting of alternate bands of red and greyish green, as distinct as possible. As another example of metamorphism by loss of matter, I might mention the intrusion of trap into coal, where the

coal is coked in the immediate vicinity of the trap, and certain volatile products are formed, the coal suffering loss of matter in this case; but it is astonishing to observe to how slight an extent, apparently, this alteration due to the intrusion of trap takes place. I have very often particularly noticed this in collieries where trap has been intruded.

Intermixture with contiguous matter is another source of metamorphism. I will mention one example, where a pyroxenic rock, of which Bunsen speaks very copiously in his paper on the volcanic phenomena of Iceland, is traversed by a dyke of trachyte. This dyke in the interior is pure white, and becomes darker and more ferruginous as it approaches the surrounding rock. He took specimens, and analysed them, from the interior of the dyke, from the cheek of the dyke, and also from a part of the surrounding rock. I should tell you that Bunsen, in this paper, says that two kinds of materials have been ejected by volcanic action. One of these is typified by the trachytic rock, which is rich in silica, containing about 80 per cent. of silica. Obsidian is an example of this material. The other substance is the pyroxenic mass, containing about 50 per cent. of silica. These are the details of the analyses of the three kinds of specimens which Bunsen procured:—

	From the centre of the vein.	From the cheek of the vein.	From the rock immediately surrounding the vein.
Silica . . .	78.95	66.18	50.25
Alumina . . .	7.71	9.74	12.55
Protoxide of iron	4.32	12.05	16.13
Lime . . .	1.55	4.49	11.10
Magnesia . . .	0.42	3.04	7.59
Potash . . .	2.48	0.94	0.34
Soda . . .	4.57	3.56	2.04
	100.00	100.00	100.00

The material taken from the cheek of the vein or dyke represents a mixture of 0.6 of the pyroxenic mass with 1.0 of Bunsen's normal trachyte, which is well typified by the analysis of the substance taken from the centre of the dyke. He finds from these three analyses that there has been a most gradual passage from the trachytic dyke into the pyroxenic rock, as the two came in contact. This, then, is an example of metamorphism by admixture with contiguous matter.

Metamorphism is occasioned also by thermo-hydric action. I take these two Greek words, though I might call it "thermo-aqueous," which appears to me to be a very good term to express this process. I have already brought before you several remarkable instances of this action when speaking of Daubrée's researches. You will remember the action of water at 400° C. upon glass. In some of the experiments part of the glass operated upon was only exposed to steam. This is a point well deserving of careful note. The tubes were not filled, but notwithstanding, the portion of the glass exposed only to the action of steam was acted upon with equal intensity with the glass exposed to the direct action of the liquid water. This is a point which really has an important bearing on geological phenomena, considering the influence, or what may be the influence, of superheated steam. The natural volcanic glass, obsidian, you remember, was similarly acted upon by water at this high temperature. It completely lost its vitreous character, and was changed into a crystalline fine-grained trachyte. The powder under the microscope presented all the characters of felspar. Obsidian differs from felspar in containing a little more silica, and this is easily removed along with the alkaline silicate dissolved out of the glass, the residue consisting of felspar. Further, I may call to your recollection that pure kaolin—china clay—when heated under similar conditions with the concentrated water of the mineral springs of Plombières, which contains alkaline silicate in solution, under-

went a remarkable transformation. It was changed into a solid confusedly-crystallised substance. The crystals were in small prisms, which scratched glass. This substance was not acted upon by hydrochloric acid. It was a double silicate of alumina and alkali, having all the properties of felspar, and was mixed with a little crystallised quartz. Thus, then, you take this pulverulent amorphous stuff, china clay, and by exposing it to the action of hot water, such as we find existing in various parts of the world—thermal springs containing a little alkaline silicate in solution, you effect the transformation of the china clay into a perfectly solid, compact, felspathic rock. Thus, in nature, argillaceous beds may have been readily felspathised by the permeation of water containing alkaline silicate under great pressure, and at a high temperature. The quantity of water required for this purpose is very small—not greater even than that found mechanically mixed with the rocks themselves *in situ*. There is another point deserving of remark. The glass operated upon by Daubrée had acquired a decidedly slaty structure, cleaving easily into leaves so thin that more than ten could be distinguished in the thickness of one thousandth of a metre. It recalled, he says, the structure of certain crystalline slaty rocks.

As an excellent illustration of metamorphism which appears to have been effected by thermo-hydric action may be cited the observations of Daubrée, near Rothau, in the Vosges. Syenitic granite, as he terms it, has penetrated Devonian beds, which, even to the distance of several hundreds of metres from the point of contact, are entirely modified. In certain points the rock is wholly formed of a mixture of lamellar augite, epidote, and compact garnet, with some galena. In the middle of the rock formed of these silicates, Daubrée found numerous polypes perfectly well preserved. Even the cavities left by the partial disappearance of the calcareous substances of these polypes was studded over with crystals of the same mineral as formed the matrix. The most abundant was black hornblende, in elongated, perfectly defined crystals, penetrating occasionally into the crystals of quartz, as is frequently seen in the middle of rocks, having lost all traces of fossils. Grass-green garnet, moreover, occurs, completely recalling that of Monzoni, in the Tyrol, and of Drammen, in Norway. Large crystals of axinite were also discovered by Daubrée, of which the presence had not been previously recognised, under similar conditions, in fossiliferous rocks. I will now give you his *résumé*, translated as near as possible. He remarks:—"The organic remains so well preserved at Rothau deserve to be regarded as classical monuments of metamorphism. They teach us, in fact, that a rock incontestably of sedimentary origin is now formed of anhydrous and crystallised silicates, such as augite, hornblende, garnet, epidote, and axinite; and, further, that this rock has been profoundly transformed without notably softening, since the *délicatesses*" [as he terms them: we cannot find exactly the same word in English] "of the surface of the polypes are well preserved in it." Metamorphism of this kind explains how the angular edges of numerous fragments, which are very often met with in granites from the most different localities, should have been preserved. Daubrée insists especially upon the connection between the metamorphism of stratified beds and dislocation, and the connection of dislocation with the occurrence of thermal waters. All that you require is immense pressure at great depths and corresponding degrees of temperature. He has calculated that over three-quarters of the globe thermal waters cannot rise except by overcoming the pressure of the water of the ocean, which on the average may be taken at 200 atmospheres.

Another mode of metamorphism is by the removal of part of the constituents of a rock by the mechanical action of water. The washing out of argillaceous, ferruginous, or other mechanically-mixed matter from a sandstone rock, and the transformation of this into quartzite, which is re-

garded as a metamorphosed sandstone, is an instance of this kind of metamorphism. The blending together of the grains of quartz may be so intimate as to have obliterated the evidence of the original structure, and the rock might be supposed to have been deposited as such from water; but, according to Coquand, with attention, it is easy to discover rounded grains of quartz, and to establish the passage from sandstone into quartzite. Subsequent to the removal of foreign matter there may be agglutination of the grains by the deposition of dissolved silica.

There is metamorphism by the solvent action of liquids. This is a very important part of our subject. I may mention, as an example, water containing carbonic acid in solution. This solvent action takes place on a large scale upon the so-called igneous rocks containing silicates, which are slowly decomposed by water impregnated with carbonic acid. The matter dissolved out may be again deposited in various states of combination, as we have seen in a previous lecture. I spoke especially of the decomposition of silicate of lime by this means. I now just recur to it in order to bring it in as part of this series of metamorphic actions.

Metamorphism takes place by the deposition of matter from solution. Silicification is an example of this kind of metamorphism. At Kolmar, in Alsace, muschelkalk in contact with granite is changed into hornstone from the action of springs containing silica. The same is observed in Kentucky and Indiana on a great scale.

We have also a metamorphism by double decomposition from the action of aqueous solutions. This is a point which has been only very imperfectly investigated. You will remember that we examined some of the theories on this subject with reference to the formation of dolomite.

Metamorphism by the addition of water is another mode in which this phenomenon occurs. As an example of this I may mention that anhydrite—the anhydrous form of gypsum—may be seen at St. Gothard in every stage of conversion into gypsum. At Berry Head, near Torquay, I think I have observed something of the same kind in a vein of red hæmatite, or red iron ore. I got specimens of the red iron ore from above and below. Where it was being constantly washed by the water of the sea it appeared to be passing into brown oxide of iron.

There is also metamorphism by oxidation and hydration. Take the case of carbonate of protoxide of iron in our coal measures, which is converted into brown iron ore by exposure to the weathering action of air and moisture. This action must have prevailed over large areas. There is no doubt that those extensive deposits of brown ore in Northamptonshire have been produced in this way, having been originally carbonate of iron, which has been converted, by the conjoint action of air and moisture, into brown ore of which the deposits now consist.

Metamorphism is occasioned in some cases by volcanic exhalations. Amongst these exhalations I may mention steam, hydrochloric acid, carbonic acid, and sulphuretted hydrogen. We shall consider these more particularly in our next lecture. As an example of such metamorphism, I may mention obsidian, which is decomposed by the hydrochloric acid vapour, leaving a residue of white clay, the iron being dissolved out and washed away. There is a volcano in Java, the whole crater of which is filled with boiling mud, from which hydrochloric acid escapes. It is dangerous even to approach this volcano, in consequence of the changes produced by the action of the acid. We have already mentioned the production of gypsum in Iceland by the action of sulphurous acid on palagonite rock. We have sulphuretted hydrogen in mineral springs, and this doubtless has played an important part in the production of many metalliferous veins. The hydrogen of the gas becomes oxidised by the action of the air, and the sulphur is deposited. Is any sulphurous acid formed with or without the presence of carbonate of lime? If so, sulphite of lime would be produced, and would be afterwards changed into sulphate of lime. At Aix and in Tuscany there are

springs containing sulphuretted hydrogen rising through limestone which is changed into gypsum in the vicinity of the springs.

The last observation I have to make relates to a point of great importance, which has been brought forth quite recently and very prominently by Bischoff. It is the change of volume consequent on the decomposition of igneous rocks by carbonic acid and water. We know that they have been derived from pre-existing rocks, and this change can only have been effected, or to a great extent, at all events, by carbonic acid. The decomposition of the silicates of these rocks has been effected mainly, without doubt, by the action of carbonic acid. Carbonates have been produced, and the silica has been separated. This action gives rise to an enormous difference of volume. We will take, for example, basalt, having a volume of 33.33. On weathering that basalt, and converting it, by the action of carbonic acid, into quartz, kaolin, carbonate of iron, carbonate of lime, carbonate of magnesia, carbonate of potash, and so on, that volume of 33.33 becomes 70.93. Now, imagine a great rock, consisting of silicates, thus decomposed, and converted into these substances—quartz, kaolin, and so on—by the action of carbonic acid, and see what a great increase of volume must have taken place. Probably this is an action which may have played an important part, at all events, in the conformation of land. One other consideration, and I have done. The decomposition of these rocks by carbonic acid involves the extraction of that gas from the atmosphere, and its fixation. To this subject Eblemen has called attention in a very prominent way. The conclusion is, that in ancient periods there must have been carbonic acid in the atmosphere to a much greater extent than at present, and that it must have been slowly removed. There is no doubt that it must have been a very influential geological agent.

NOTICES OF BOOKS.

The Scottish Black-rain Showers and Pumice-stone Shoals of the Years 1862 and 1863. By the Rev. JAMES RUST, A.M., Minister of Slains. Edinburgh: Blackwood and Sons. 1864.

TUESDAY, January 14, 1862, will be a day long remembered by the washerwomen and gudewives of Slains, a parish lying on the coast of Aberdeenshire. The weather for the fortnight previous had brought plenty of soft water for washing, but of necessity had been eminently unfavourable for drying. The morning of Tuesday, however, opened bright and clear, with a pleasant breeze from S.S.E., which promised well for the final success of laundry operations, and we may imagine the women "up in the morning airly," and soon the snow of well-washed linen covered the greens around the village.

But there was nae luck about the house upon that washing day. Later in the morning the estimable minister of the parish, looking out of the manse window, saw far out at sea a "large, dense, black, smoky, fearful-looking cloud" driving shorewards. As it came on it sent forth a heavy shower of rain, which—worse than a Scottish mist—proved a decided mystification. The water that fell was black as ink, and the consternation of the gudewives as they regarded the appearance of the linen on which they had bestowed so much soap and labour, may be more easily imagined than described.

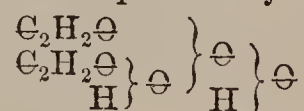
Nor was the gudeman saved from all vexations. He wanted soft water to shave himself with, and the sooty mixture brought from the butt curdled and mottled, but obstinately refused to make a lather. It was unequivocally acid, and had moreover a sulphurous smell; altogether it seemed clear that the Prince of Darkness must have been at work in the parish of Slains that day.

But the black rain was not the only startling phenomenon. Immediately after it fell the sea floated to land, and left stranded along the shore, vast quantities of pumice-stone, some fragments of which weighed as much as half a pound.

Whence could these and the soot and sulphur have come? That is the question which the Rev. Mr. Rust sits himself down to answer, and after investigating several theories propounded, finally connects the phenomena with an eruption of Vesuvius which happened two days before they occurred. To go further into the matter would be to deprive our readers of some of the pleasure of reading a well-written, amusing, and instructive little book, to which, therefore, we refer them for the full narrative and, to our mind, conclusive reasoning of the author.

Annalen der Chemie und Pharmacie. June, 1864.

THE journal opens with a paper by Heintz "*On Diglycolic Acid*," the conclusion arrived at being that the constitution of this body is best expressed by the formula—



"*A Contribution to the Knowledge of Coniine*," by Wertheim, details an elaborate determination of the vapour density of *Azoconhydrin* $\text{C}_8\text{H}_{16}\text{N}_2\ominus$, and also the properties of *Conylen*, and some of its derivatives—bodies of small interest to our readers.

Translations of papers by Dr. Stenhouse "*On Nitro-Erythroglucin*" and "*On Munjct*" follow.

An account of "*Some Experiments on Vegetation*," by Dr. Stohmann, succeeds, the results of which show that maize is a much more exhausting crop than beans, and that after a maize crop you may safely calculate on a good yield of beans; and further, that from a soil from which you can reap no maize you may gather a rich crop of beans.

Papers by H. Hlasiwetz and Barth "*On New Products of the Decomposition of Guaiacum Resin*," and on a new body homologous with orcin and obtained from galbanum, we have referred to before.

Dr. Frankland's paper "*On the Combustion of Iron in Compressed Oxygen*" is also translated. The only other paper we need mention is a short one on the properties of cuprous chloride. This salt, it is well known, darkens when exposed to light, in consequence, says the author of this paper, of the formation of an oxysubchloride. The author gives an easy method of preparing cuprous chloride, which consists in dissolving equal equivalents of sulphate of copper and common salt and passing sulphurous acid through the solution. The cuprous chloride separates out as a white crystalline powder, which must be washed by decantation with aqueous sulphurous acid.

The Ophthalmic Review: a Quarterly Journal of Ophthalmic Surgery and Science. Edited by J. Z. LAURENCE and T. WINDSOR. No. 2. London: Hardwicke.

"ONE of the chief features in the recent progress of Ophthalmic Surgery," says one of the editors in a paper "*On some Ophthalmic Instruments*," "is its gradual tendency to assume the characters of the more exact sciences," which is, unhappily, more than can be said of any other branch of medical science. The object of the *Ophthalmic Review* is to promote this gradual tendency, and it deserves every success.

Poggendorff's Annalen der Physik und Chemie. No. 6. 1864.

THE chemical papers in this number are confined to a short abstract of Mr. Robbins' paper "*On Oxygenesis*," and another "*On the Relative Atomic Volume of Undecomposed Bodies*," by P. Kremers.

The Retrospect of Medicine, &c., &c. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. xlix. January to June, 1864. London: Simpkin, Marshall, and Co. 1864.

WE may content ourselves with announcing the punctual issue of this extremely useful serial.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 15, Southampton Buildings, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1533. Wilhelm August Abegg, Westminster Palace Hotel, Victoria Street, Westminster, "Improvements in apparatus for distilling spirituous liquors."—A communication from Carl Falkman, St. Petersburg, Russia.

1538. William John Pughsley, Christ Church, Monmouthshire, "Improvements in obtaining sulphuric acid from the refuse 'pickle' used in tin-plate works, and also from sulphate of iron or green copperas."

1543. Thomas Ogden Dixon, Steeton-in-Craven, Yorkshire, "Improvements in stoppers for bottles, jars, and similar articles, and in means or apparatus for withdrawing such stoppers from bottles, jars, and similar articles."

1545. James Forbes, Old Ford, Bow, Middlesex, "Improvements in the means of, and apparatus for, manufacturing sulphate of ammonia and sulphuric acid."—Petitions recorded June 21, 1864.

1375. Frederick Oldfield Ward, Hertford Street, May Fair, Middlesex, "Improvements in processes and apparatus for treating alkaliferous minerals to obtain alkalies, alkaline salts, alumina, and accessory products."—Petition recorded June 2, 1864.

1523. Richard Jones, Botolph Lane, Eastcheap, "An improved method of preserving animal and vegetable substances."—Petition recorded June 20, 1864.

1571. Joseph Tirat, Russell Place, Fitzroy Square, Middlesex, "A new voltaic apparatus for the relief of hernia in all its forms and stages."

1577. Archibald Turner, Leicester, and James Clark, Manchester, "Improved machinery or apparatus for vulcanising india-rubber, which machinery or apparatus is peculiarly adapted for vulcanising by the cold process, or without the application of heat."

1580. James Hinks and Joseph Hinks, Birmingham, Warwickshire, "Improvements in lamps for burning paraffin oil and other volatile liquid hydrocarbons."—Petitions recorded June 23, 1864.

1587. George Timothy Sims and John Pendley, Shadwell, Middlesex, "A new composition for preventing and removing incrustation in steam and other boilers."—Petition recorded June 24, 1864.

1599. Benjamin Franklin Stevens, Trafalgar Square, Middlesex, "Improvements in the application of petroleum, coal-oil, and other similar substances, to the purposes of heating, lighting, and obtaining motive power, and in the apparatus employed therein."—A communication from Simon Stevens, New York, U.S.A.—Petition recorded June 25, 1864.

1618.—John Augustus Bouck and Thomas Hill, Manchester, Lancashire, "An improved varnish for paper, wood, metals, or other substances, which invention is also applicable to paper and calico printing."—Petition recorded June 28, 1864.

1655. William Edward Gedge, Wellington-street, Strand, Middlesex, "Improvements in the firework known as Roman candle."—A communication from Henri Frédéric Favre-Couvet, Nantes, France.—Petition recorded July 4, 1864.

1669. George Phillips, Holborn Hill, London, "Improvements in the manufacture of aniline colours."—Petition recorded July 5, 1864.

Notices to Proceed.

507. William Henry Mellor, Liverpool, Lancashire, "An improved apparatus to be used when fermenting malt liquors in casks or other like close vessels."—Petition recorded March 1, 1864.

563. Thomas Gray, Mitcham, Surrey, "Improvements in the treatment of 'jute' and 'jute' cuttings."—Petition recorded March 5, 1864.

594. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in apparatus for stopping bottles, jars, and other vessels."

668. James Carrick, George Square, Glasgow, Lanarkshire, "Improvements in apparatus for inhaling, breathing, and respiratory purposes."—Petition recorded March 16, 1864.

827. Richard John Edwards, Bow, Middlesex, "Improvements in the mode of toughening papers and other substances to render them suitable for the application of abrasive substances and for other purposes, and in apparatus used in such manufacture."—Petition recorded April 2, 1864.

1515. Thomas Agnew, jun., Manchester, Lancashire, "Certain improvements in apparatus for coating or covering moulded or other surfaces with certain composition or material."—Petition recorded June 18, 1864.

1525. Richard Smith and Christian Sieberg, Glasgow, Lanarkshire, N.B., "Improvements in obtaining colouring matters."—Petition recorded June 20, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, July 21, 1864.

AGRICULTURAL machinery, thanks to the far-sightedness of the present Emperor, is making great way in the provinces. The *Journal d'Agriculture Pratique* announces a grand trial of reaping machines to take place at Amiens, under the auspices of the Agricultural Committee of that city, towards the end of the month, so that the farmers may see what to buy for the coming harvest. Prizes in money and medals will be given.

Your readers, who, like myself, tasted Chinese mutton at one of the late banquets of the British Acclimatisation Society, will be glad to hear the Chinese ram and ewe that were presented to the French Acclimatisation Society last year are increasing and multiplying. Last July the ewe dropped four lambs. She suckled three, and the remaining one, to whom she took a most unaccountable dislike, for it was one of the prettiest lambkins ever seen, had to be brought up by hand. Last January she dropped three more, making seven altogether, all of whom are thriving. The mother is again in that condition in which Chinese ewes like to be who love their mandarins, and seems in no way to have suffered from being in a state of confinement, or, rather, I should say, captivity, for fear of being misunderstood when speaking of these very prolific creatures. Besides their fecundity, they possess the advantage of making most delicious meat, and growing wool of great fineness and length of staple.

M. Nobel announces that by damping mining powder with nitroglycerin its explosive power is trebled, and the noise of the explosion much less than when ordinary powder is used.

In order to increase still more the constancy of the Daniel's battery, Father Secchi advises the use of fine sand or of powdered sulphur in the porous cell. He accounts for its action by supposing that when the ordinary liquid alone is used there is greater liability to local action taking place upon the zinc. In a battery, the circuit of which is closed for two minutes every quarter of an hour, the learned Father has used an ordinary piece of commercial sheet zinc, half a millimetre in thickness, which has continued in action for more than six months,

without showing the least sign of corrosion. For large elements instead of porous diaphragms he uses bags made of coarse linen cloth, well anointed with a luting of flour and lime. Those who have experienced the difficulty of procuring large porous cells would do well to test these contrivances.

The Academy of Sciences at Vienna have offered a prize of 200 ducats (about 90*l.*) for the best research on the movements of the fixed stars. The papers are to be sent in before December 31, 1865.

The new Astronomical Society, founded last year at Heidelberg, is doing good work. Some dozen of its most eminent members are computing the disturbances which have taken place in the movements of Mercury, Venus, Mars, Jupiter, Saturn, and Uranus. Some of them go back as far as 1770. The asteroids, too, are receiving great attention from a certain number of members, each taking a planet under his observation and observing its motions periodically. The society is essentially international in its character, and numbers amongst its members not only German, but English, French, Italian, and Russian astronomers. Unlike M. Leverrier's new society, the Heidelberg Society rejects the principle of giving prizes for competitive papers.

The experiments made by several leading sericulturists on the eggs of the Japanese variety of silk-worms, which were brought by M. Berlandia, have for the most part been successful. Although a large number of the eggs were infertile, yet those that did hatch produced healthy worms, most of which have now attained to the cocoon stage. The experimenters in these foreigners anticipate a large crop of eggs for next year. If the sericulturists can succeed in introducing the Japanese insect into France it will be of the utmost importance, for the spread of disease amongst the French worms has been fearful of late years.

A fine crystal of the raw Elban mineral pollux has just been presented to the mineralogical department of the museum of the *Ecole des Mines*. This rare mineral is interesting as, according to the researches of M. Pisani, it contains a very large proportion of cæsium. Up to the time it was examined by M. Pisani, the cæsium was always supposed to be potassium or sodium. Those who possess good collections of minerals supposed to contain these two alkaline metals, should set to work and examine them by the aid of the spectroscope. The trouble taken would doubtless be rewarded by the discovery of many other minerals besides pollux containing cæsium or rubidium, hitherto taken for potash and soda.

The Duke de Luynes and his companions have just returned from visiting the Holy Land and the Dead Sea, and have brought home with them a large number of specimens and observations of the greatest interest. It strikes me that this is a much better use to which to apply ducal revenues than cultivating the friendship of firemen and engine-drivers.

A Case of Dialysation.

To the Editor of the CHEMICAL NEWS.

SIR,—In preparing solutions of vegetable acids in a large manufactory lately where, as usual, the solutions are separated from an insoluble residue which is washed until tasteless, I found in one of the filters an impossibility of accomplishing this, the acid taste remaining, although water freely percolated through the mass; and on closer examination I found that the filtered liquor, which originally contained only a very small percentage of sulphuric acid, now consisted almost entirely of it, the crystallisable acid having been kept back by the precipitate, which in this case seems to have acted as a dialyser. I may further add that as soon as there was more space allowed below the false bottom, so that the liquor could not remain at all in contact with the precipitate, this effect ceased. Thinking this fact may be of interest to some of your readers,

I am, &c.,

CHEMICUS.

Solubility of Gold.

To the Editor of the CHEMICAL NEWS.

SIR,—While examining an alloy of silver and gold for the purpose of ascertaining the percentage of gold that it contained, I found, to my surprise, that a mixture of sulphuric acid and nitric acid dissolves gold to a considerable extent. This fact seemed to be of some importance, and being unaware of a similar observation having been hitherto made, I send you a note of it.

I am, &c.,
A. REYNOLDS.

MISCELLANEOUS.

SIMPSON v. HOLLIDAY.

THIS was a trial, without a jury, before Vice-Chancellor Page Wood. Substantially the case was the same as that of Simpson v. Wilson, tried before Lord Chief Justice Cockburn, in December, 1862, and fully reported in vol. vii. of the CHEMICAL NEWS. We need now, therefore, only recapitulate the leading points in the evidence.

The patent in dispute is that of Medlock for producing Magenta colour by operating on aniline with *dry* arsenic acid, and the case turns upon the meaning of the word *dry* in the specification. By *dry* arsenic acid is it meant the anhydrous acid containing absolutely no water, or is it the hydrated acid which is dry to the senses? The latter is the meaning contended for by the plaintiff, and the former by the defendant, who urges that, inasmuch as that anhydrous acid will not produce the colour, the patent is void.

The first witness called was Mr. E. C. Nicholson, one of the plaintiffs, who, in reply to questions by Mr. Grove, stated that he had made and sold arsenic acid before the date of Medlock's patent. He sold it in the dry state. The term dry is constantly applied to bodies which contain water; what is called dry lime contains 39 per cent. of water; dry alum may contain 50 per cent. of water. He supplied Dr. Medlock with the dry commercial arsenic acid. In making the colour he preferred to use a solution of arsenic acid, and to heat the mixture until the water of solution was driven off, and only the water of hydration left. No colour is produced as long as water is present. In his judgment there was no chemical difference between producing the colour by using water and boiling it off, and making it in closed vessels with dry arsenic acid. The chemical reaction is the same in both cases. The object of specifying dry acid was to get at something like a proper proportion of acid to use. It is a better indication of proportion.

In cross-examination by Mr. Hindmarsh, the witness stated that the process given in several books for making arsenic acid would produce the dry but not the anhydrous acid. In order to obtain the colour it was necessary to form arseniate of aniline, which could not be formed without water. Dry arsenic acid with 14 per cent. of water would probably unite with an equivalent of aniline to form arseniate. Practically he used 75 per cent. of solid arsenic acid and 25 per cent. water, which would really amount to 32 per cent. of water, and 68 of anhydrous acid. The use of water is entirely mechanical; therefore, within certain limits, the larger the quantity of water you employ, the better combination with aniline you get. 25 per cent. of water answers very nicely. Dry arsenic acid will combine with aniline; anhydrous will not. If you mix anhydrous acid, aniline, and water, the acid must first combine with the water before arseniate of aniline is formed. No colour will be produced until the water of solution has been driven off, and a temperature of about 320° is reached. A mixture of arsenic acid with 25 per cent. of water and aniline, heated in a sealed tube to 370°, produced very little colour, showing that it is necessary to get rid of the water.

Re-examined by Mr. Grove: The proportions we use are six gallons of aniline to four gallons of a solution of arsenic acid containing 25 per cent., which will yield about 62 lbs. of arsenic acid, and 60 lbs. of aniline. The exact proportions are not important, so long as you have an excess of aniline, that is a *sine qua non*.

Dr. Hofmann was next examined. He stated that the word "dry" had been loosely employed by chemists, sometimes to indicate anhydrous materials, and at other times hydrated bodies which were dry to the touch and eye. This case will introduce greater precision into the language of chemical manuals. Whether the word "dry" means anhydrous or not must be judged from the context.

Dr. Odling examined: He said he was not misled by the use of the word "dry" in the specification. In the majority of instances when the word "dry" is used in chemical books, it simply means dry to the touch.

The remainder of the evidence for the plaintiffs is really but a repetition of the foregoing statements. On the second day an experiment was made in court to prove the colour produced in a sealed tube was very small in comparison with that formed when aniline and dry arsenic acid are heated in the open air.

For the defendant, Dr. W. A. Miller was first examined. He stated that in his own book on Chemistry "dry" arsenic acid is spoken of as an anhydrous substance. Before these trials, dry and anhydrous were used as convertible terms with reference to arsenic acid. He was familiar with arsenic acid in the anhydrous form before the trial. No colour is produced by the action of anhydrous arsenic acid upon anhydrous aniline. But colour is produced when aniline and a solution of arsenic acid are heated in a sealed tube.

Mr. D. Campbell, Drs. Taylor, Letheby, and Wanklyn gave similar testimony. Evidence was also given by manufacturing chemists who had supplied or had been applied to for fused and vitrified arsenic acid by Messrs. Hands and Son, of Coventry, who held the first assignment of Medlock's patent.

The hearing of the case lasted six days.

On the 15th the learned Vice-Chancellor gave judgment in favour of the plaintiff; but we understand that the defendant has signified his intention to appeal.

ANSWERS TO CORRESPONDENTS.

* * In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

* * All Editorial Communications are to be addressed to the EDITOR and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

A Reader.—We are not aware that the substance formulated has ever been prepared.

Dr. L. Schad.—It might answer our correspondent's purpose better, perhaps, if the mistake were not mentioned.

M. O.—There are two volumes of the *Philosophical Magazine* every year, beginning in January and July, price 17s. 6d. per vol. *Repertoire de Chimie, &c.*, one vol. a-year, beginning in January. For price ask foreign bookseller.

A Young Chemist.—1. Burn with soda lime, and determine ammonia by standard acid as described in the manual. 2. The smell is proper to the oil, and could not be removed without destroying it.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on Oxygen, by Dr. G. MEISSNER.

(Continued from page 13.)

MANY very strong saline solutions and some dry substances have the power of removing for a time the atmizone cloud, without, however, destroying its power of reproduction. So, for example, act concentrated solutions of the chlorides of sodium, potassium, and barium, iodide of potassium, sulphate of magnesia, and caustic potash. These solutions produce their effect only by their power of retaining moisture. Dilute solutions of the same salts do not affect the cloud, concentrated destroy it by retaining the water.

The question that next arises is, How much water does the cloud contain? and by comparing the capacity for water of a stream of unelectrised air with that of an electrised stream, by passing an equal volume, in the same time and at the same temperature, through a chloride of calcium tube, the author found that the increase of weight in the latter case was nearly double that in the former.

Atmizone, in the presence of a sufficient amount of water, and in the course of half or three-quarters of an hour, gradually loses its peculiar properties, even when the external conditions are not at all changed. During this time it enters into no new combinations, but only reverts to the condition of ordinary oxygen.

That the attraction of atmizone for water gradually becomes weaker and weaker, is shown not only by the fact that the first attracted cloud-water is gradually precipitated, but by another and most striking experiment. There are fluids containing water from which the atmizone, immediately after its formation, and before it has had the opportunity of becoming saturated, can extract water, while the same fluid later not only gives up no water, but on its part abstracts the moisture. If a deozoneised electrised stream be first passed through alcohol (80 per cent.), afterwards through water, once more through strong alcohol, and then again through water, there will be seen on the first alcohol a thin cloud, which will last as long as the experiment is continued; on the water in the second receiver the air will be strongly cloudy, but in the second alcohol receiver the cloud will be completely lost, and the air will pass in the second water receiver quite transparent, but will again appear on the surface of the water. Thus the first alcohol must communicate some water, while the second withdraws it.

The behaviour of concentrated saline solutions is no doubt similar, and the gradual alteration of the atmizone is also noticed when the deozoneised air is passed through a succession of vessels of water.

From the foregoing it is seen that the atmizone begins to change as soon as it comes to rest with the vapour of water, and therefore it follows as a rule that the series of vessels through which we pass the electrised air in our experiments on this body, must be of the smallest possible dimensions, so that the mass of air may not be detained long in part of the passage. The rapidity of the stream of air, the author found, must also be regulated, and he found in his experiments that he obtained the best results by passing four or five litres through the apparatus in an hour. The vessels in which the deozoneisation of the air was effected, and those in which the subsequent saturation with aqueous vapour, and the experiments on the action of atmizone took place, had a

capacity of from 40 to 60 cc., except in cases when larger dimensions were required.

We have hitherto been dealing only with moist, or with moisture-saturated atmizone, let us now see how the dry behaves in the course of time. If we dry the stream of air (previously deozoneised by passing through a concentrated solution of iodide of potassium) by passing it through a chloride of calcium tube or sulphuric acid, and fill dry glass flasks with the mixture of dry atmizone and air, we can study the behaviour of the atmizone by opening the flasks from time to time, and shaking it with a little water. It will then be seen that the first opened will form a strong cloud; but it will be observed that the cloud-forming power is gradually lost in the later-opened flasks, and after a certain period is completely absent. The change proceeds more slowly with the dry than the moist atmizone, and takes place only in an hour or an hour and a half.

Under the same conditions in which atmizone so quickly disappears without entering into any chemical combination, ozone is, on the contrary, very permanent. If a capacious flask containing a little water be filled with electrised but not deozoneised air, and well closed so that the air is only in contact with glass and pure water, the atmizone disappears in a short time. The greater part of the ozone, however, remains unchanged, and its presence in the flask may be proved after several months. That some ozone disappears is beyond doubt; but the diminution is not considerable; the smell retains its full intensity, and the oxidising action is as energetic after months as it was at first.

(To be continued.)

Analysis of the Mineral Pollux of the Island of Elba, by M. F. PISANI.

POLLUX is a very rare mineral, of which there exists only the incomplete analysis of Plattner, in which he found chiefly silica, alumina, potash, and soda.

M. Pisani, having at his disposal a beautiful specimen of this substance, has made a complete and interesting analysis, finding in it an abundance of caesium, and this is the first time a mineral has been proved to contain this metal as a really constituent part.

The density of this specimen is 2.9; its lustre glassy and colourless; its hardness about 6.5. On analysis it gave,—

Silica	44.03
Alumina	15.97
Oxide of iron	0.68
Lime	0.68
Oxide of caesium (Cs = 133) (traces of potash).	34.07
Soda (with a little lithium)	3.88
Water	2.40

The rose-coloured lepidolite of Elba contains almost as much rubidium as that of Rozena, and about a fourth as much caesium as rubidium. — *Bulletin de la Société Chimique*, vi., 456, 1864.

On the Employment of Fluohydrate of Fluoride of Potassium in Analysis, by WOLCOTT GIBBS, M.D., Rumford Professor in Harvard University.

(Continued from page 37.)

Hyponiobic Acid.—I am indebted to the kindness of Professor B. Silliman, jun., for a liberal supply of columbite from Middleton, Connecticut. Mr. F. W. Tustin has found that the finely-pulverised mineral treated with a solution of three times its weight of fluohydrate of potassium is almost completely resolved.

during the mere process of evaporation to dryness. The dry white powder thus obtained by fusion in a platinum crucible gives a beautiful rose-coloured mass, which is easily separated from the crucible, and which, in a moist atmosphere, falls to a crystalline powder. On boiling with water acidulated with fluohydric acid a clear solution is obtained, from which, on cooling, hypo-fluoniobate of potassium separates in colourless crystals. By repeated crystallisation, the salt may be obtained free from iron and manganese, but containing an excess of fluoride of potassium. It is better, however, to pass a current of sulphydric acid gas through the solution to remove traces of tin and tungsten, and reduce the iron to proto-fluoride, and afterwards to evaporate and crystallise.

When the object in view is simply to prepare perfectly pure hypo-fluoniobate of potassium, it is better to fuse one part by weight of columbite with two of fluohydrate of potassium. The fused mass has then a greenish tint. It must be rubbed to very fine powder before boiling with water acidulated with fluohydric acid. After passing sulphydric acid gas through the solution and filtering, the hypo-fluoniobate crystallises in colourless acicular crystals, which must be purified by repeated crystallisation. The salt is much more soluble in hot than in cold water. In this process a considerable quantity of fluosilicate of potassium, fluoride of calcium, quartz, and other impurities, usually remain upon the filter, with the sulphides of tin and tungsten. The difficulty in this process consists in separating the iron when, as in the mineral columbite, this is present in comparatively large quantity. In this case very large platinum or silver vessels, and numerous recrystallisations, become necessary. It is better, therefore, in preparing large quantities of pure hyponiobic acid, to fuse with fluohydrate of potassium, dissolve the fused mass in water as before, and filter to separate quartz, fluosilicate of potassium, and fluoride of calcium; evaporate the solution to dryness, and heat with pure sulphuric acid until the whole of the fluorine is expelled. By diluting with water and boiling, the whole of the hyponiobic acid is precipitated. If, after the precipitation, Rochelle salt is added, and the whole is boiled, the hyponiobic acid will be almost completely free from iron, manganese, tungsten, and tin. After thorough washing, it may be again fused with fluohydrate of potassium, and the double fluoride obtained perfectly pure by re-crystallisation.

Chromic Iron Ore.—Mr. P. C. Dubois has found that the finely-pulverised ore may be completely resolved by fusing it at a red heat for ten or fifteen minutes over a blast lamp with four or five times its weight of fluohydrate of potassium. The fused mass has a clear green colour. By treating this with sulphuric acid until the whole of the fluorine is expelled, and then adding water, the chromium iron and aluminium are completely dissolved as sesqui-salts. Perhaps the easiest method of separation is the following:—To the solution an excess of caustic soda is added, after which, without filtering, chlorine gas is to be passed through until the sesquioxide of chromium is converted into chromic acid. The solution is then to be heated to expel excess of chlorine, nitric acid added in slight excess, and the sesquioxide of iron and alumina precipitated by ammonia. To the filtrate acetic acid is to be added in small excess; after which the chromic and sulphuric acids may be precipitated together by acetate of lead. The precipitate, after washing, is to be boiled with chlorhydric acid and alcohol, the lead separated as chloride, and the chromium determined in the usual

manner as sesquioxide. This method gives a complete separation, even when magnesia and nickel are present in the ore.

From what has been said it will appear that fluohydrate of potassium possesses peculiar advantages in resolving those minerals which contain metallic acids of the type RO_2 , or hyponiobic acid. The salt is easily prepared in a state of purity, and may be preserved in vessels of lead or of vulcanised india-rubber or gutta-percha. — *American Journal of Science*, vol. xxxvii., p. 346.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 29.

“On the Classification of the Elements in relation to their Atomicities,” by Professor ALEXANDER W. WILLIAMSON, F.R.S., President of the Chemical Society, &c.

THE speaker proposed to bring under the consideration of the members some of the chemical grounds for doubling the atomic weights of all the metals in Gerhardt's system of atomic weights, excepting the alkali metals, silver, gold, boron, and the metals of the nitrogen series. A change which has been proposed mainly on physical grounds by Cannizzaro, and which seems to be obtaining the approbation of more and more chemists.

TABLES OF ATOMIC WEIGHTS.

1st Class of Elements, which only furnishes an even number of atoms to each Molecule:—

Fl = 19	H = 1	N = 14
Cl = 35.5	Li = 7	P = 31
Br = 80	Na = 23	As = 75
I = 127	K = 39	Sb = 122
	Rb = 85	Bi = 210
	Cs = 133	B = 11
	Tl = 203	Au = 196
	Ag = 108	

2nd Class of Elements, which sometimes furnishes an odd, sometimes an even number of atoms to one Molecule.

O = 16	C = 12	G = 9
S = 32	Si = 28	Yt = 64
Se = 79.5	Ti = 50	Ce = 92
Te = 129	Sn = 118	La = 92
Ca = 40	Mo = 96	Dy = 96
Sr = 87.5	V = 137	U = 120
Ba = 137	W = 184	Zr = 89.5
Pb = 207	Pt = 197	Ta = 138
Mg = 24	Ir = 197	Cb = 195
Zn = 65	Os = 199	Th = 238
Cd = 112	Ro = 104	
Hg = 200	Ru = 104	
Al = 27.5	Pd = 106.5	
Fe = 56		
Cr = 52.5		
Mn = 55		
Co = 58.5		
Ni = 58.5		
Cu = 63.5		

It is now about twenty years since Gerhardt drew attention to the error of the molecular weights, or equivalent weights, as he called them, which represented water as consisting of one atom of oxygen and one of hydrogen, and proposed to double the atomic weights of oxygen and of carbon.

If Gerhardt had taken Berzelius's atomic weights and, while translating them into the hydrogen scale, had halved the atomic weights of the alkali metals and boron, he would have given us at once the system which we now adopt, saving the rectification of a few formulæ, such as that of silver and oxide of uranium, &c.; whereas by

merely doubling oxygen, sulphur, selenium, and carbon, in the then existing system of atomic weights in the hydrogen scale, he really introduced a system in which there are between 30 and 40 atomic weights to correct, in lieu of one which needed only five or six such corrections. It would be unreasonable to apply this fact in any degree to the disparagement of Gerhardt's work. It only shows how tortuous is the road which leads to truth.

The discussion of the question involves chiefly the consideration of the classification of the elements under the respective heads of chlorine and of oxygen.

The first tribe containing those elements of which an atom combines with one atom of hydrogen or chlorine, or with three or with five, &c., whilst the second tribe contains elements of which each atom combines with two atoms of chlorine, or other monads, or with four, or six, &c. The speaker did not, however, recommend that the two great classes of elements be thus distinguished from one another, for our chief evidence of atomic weights is derived from the study of the molecular weights of compounds, and the molecule is the unit to which results must be referred.

The first class is best described as furnishing only an even number of atoms to each molecule, whereas the second class sometimes furnishes an even, sometimes an uneven, number of atoms to one molecule. The process of classifying the elements has followed the very natural order of establishing a certain number of well-defined families, which were subsequently connected together by erratic members, which occasionally left their usual place to go over to some neighbouring family. Chlorine, bromine, and iodine have long been acknowledged to constitute a natural family; and there are some, though hardly sufficient, reasons for placing fluorine at its head. The three elements have the same vapour volume as hydrogen in the free state, and we accordingly represent their respective molecules as $\text{Cl}_2, \text{Br}_2, \text{I}_2$, corresponding to $\text{H}_2 = 2$ vols. They form hydrides of similar composition, and analogous properties, and of the same vapour volume. Their compounds with most metals are analogous, and have the same atomic heat and general crystalline form. Their corresponding oxygen acids also exhibit considerable analogy.

With organic radicals they form neutral ethers, like $\text{ClC}_2\text{H}_5, \text{ClC}_2\text{H}_3\text{O}$, and no acid ethers. So that when a molecule of alcohol or of acetic acid is replaced by chlorine, two atoms of chlorine take the place of one atom of oxygen, and give rise to a molecule of chloride of ethyle and a molecule of hydrochloric acid. They replace hydrogen atom for atom, taking out one, two, or three atoms, &c., according to circumstances. Their hydrogen compounds are all monobasic acids; for if, in a given quantity of hydrochloric or hydrobromic or hydriodic acid, we replace part only of the hydrogen by potassium, we get at once a neutral salt mixed with the remaining acid, which is undecomposed, and never an acid salt of the alkalies. Fluorine in this respect exhibits an anomaly which tends to remove it from this family to a biatomic one. For the acid fluoride of potassium is a well-defined compound of considerable stability, of which the existence points to the atomic weight 38 for fluorine, and the formula H_2F for hydrofluoric acid. Hydrofluoric acid, moreover, combines with various metallic fluorides—such as fluoride of silicon and fluoride of boron; and there are double fluorides of aluminium, &c., with alkaline fluorides, both well known and easily formed.

Similar double salts are, however, formed by chlorine; for instance, tetrachloride of gold combines with a molecule of hydrochloric acid, or of an alkaline chloride. Tetrachloride of platinum combines with two molecules of hydrochloric acid or of chloride of potassium, &c.

It is not possible to reconcile the constitution of these and similar bodies with one another and with the simpler compounds of chlorine, by any theory representing it as polyatomic, and as holding together the metallic atoms in

these salts in virtue of its polyatomic character. On the other hand, hydrochloric acid and metallic chlorides of opposite properties cannot be assumed to be incapable of uniting with one another, while it is well known that oxides of basylous properties unite with those of chlorous properties. Hydrochloric acid unites with ammonia, and we do admit that the two molecules are bound together into one by a chemical force of combination, and not by any tetratomic character of the hydrogen; and HCl or KCl combines, with SO_3 by a similar force.

Again: oxygen, sulphur, selenium, and tellurium are admitted to be truly analogous elements, for the parallelism of oxygen salts, and sulphur salts, affords abundant proof of the analogy of oxygen and sulphur, and the molecular volume of sulphur and selenium is found by Deville to agree at high temperatures with that of oxygen.

The elements selenium and tellurium form acids analogous to sulphurous and sulphuric acids respectively. When combined with organic radicals they form compounds of the same molecular volume in the form of vapour; and when any of them, such as oxygen, replaces hydrogen in an organic body, it takes out two atoms of hydrogen at a time, replacing each couple by one atom of oxygen, as in the formation of acetic acid from alcohol.

When we partially decompose water by potassium we get hydrate of potash formed, which is a molecule of water, from which half the hydrogen is expelled and replaced by potassium, and a second atom of potassium is required to displace the remaining hydrogen.

If we compare any proto-chloride with a corresponding oxide, either of a metal or organic radical, we find that the molecule of the oxide contains twice as many atoms of the metal or radical as the chloride, and that one atom from the oxygen family is equivalent to two atoms from the chlorine family.

When oxygen in alcohol is replaced by sulphur, no breaking up into sulphide of ethyle and sulphide of hydrogen takes place, as when the oxygen is replaced by chlorine or bromine.

Among the best known compounds there are several of which one atom combines, like an atom of oxygen or of sulphur, with two atoms like hydrogen or chlorine. This carbonic oxide, sulphurous acid, and olefiant gas are capable of combining in the proportion of one atom of the radical with two atoms of chlorine, forming the compound COCl_2 phosgene, SO_2Cl_2 chloro-sulphuric acid, and $\text{C}_2\text{H}_4\text{Cl}_2$ Dutch liquid; and these molecules have the same vapour volume as steam OH_2 . But in the free state the radicals have a vapour volume double as great as the equivalent quantity of oxygen, the atoms $\text{CO}, \text{SO}_2, \text{C}_2\text{H}_4$ being as bulky as O_2 , so that whereas the molecule of oxygen and of sulphur consists of two atoms, that of carbonic oxide consists of one atom only, so also the molecule of sulphurous acid and of olefiant gas.

Another family of very marked characteristics is that consisting of $\text{N}, \text{P}, \text{As}, \text{Sb}, \text{Bi}$, each member of which combines with three atoms of hydrogen or of ethyle (C_2H_5), forming basic compounds analogous to ammonia. Their analogy in chemical reactions is also well known, as each of them forms an oxide corresponding to nitrous acid, and another corresponding to nitric acid.

The sulphides of arsenic and antimony are notorious for their great resemblance, and that of arsenious and antimonious acid is scarcely less striking. It even extends to isomorphism of their corresponding salts.

The atomic heat of the four last terms of the series is also very nearly the same, whilst that of nitrogen (examined of course as a gas) is considerably less. Then the molecule of phosphorus and of arsenic consists of four atoms, whilst that of nitrogen consists only of two, showing a variety of constitution which is by no means to be wondered at, when we recollect that these elements are not uniformly triatomic, but sometimes monatomic, pentatomic, &c., so that the molecule of free nitrogen consists

of two monatomic atoms, or two triatomic, whilst the molecule of phosphorus and of arsenic is formed on the ammonia type of one triatomic atom and three monatomic atoms.

Another family may, perhaps, be made up of carbon and silicon, both of which form volatile tetrachlorides, and are sometimes biatomic, sometimes tetratomic in their acids.

Among metals, lithium, sodium, potassium, and probably also the new metals rubidium, caesium, and thallium, have many important points of resemblance which show them to be monatomic. They replace hydrogen atom for atom, and form with many bibasic acids both normal and acid salts. Their chlorides form with tetrachloride of platinum analogous double salts, and their sulphates form, with sulphate of alumina, &c., those well-characterised salts called alums. They do not form basic salts (unless when triatomic, like thallium). They have nearly the same atomic heat.

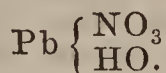
Silver is remarkable for several of the properties which we have noticed in the alkali metals. It is eminently monatomic, and disinclined to form basic salts. Its atomic heat also shows it to be monatomic. It appears to form an alum, and its sulphate has a great resemblance of form with the anhydrous sulphate of soda.

Gold also must, from its specific heat and the constitution of its two chlorides, be classed among the metals which are monatomic or triatomic. Boron is evidently triatomic in its best known compounds, as proved by the terchloride and ethylide.

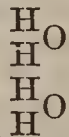
Among metals with strongly basylous properties, Ca, Sr, Ba, Pb, are connected by very close analogies. The general resemblance of their sulphates and carbonates, and the isomorphism of most of them, are too well known to need mention.

But lead has been obtained in combination with ethyle, and the compound $\text{Pb}(\text{C}_2\text{H}_5)_4$ which corresponds to bin-oxide of lead, in which the two atoms of oxygen are replaced by four atoms of ethyle, and the compound $\text{Pb}(\text{C}_2\text{H}_5)_3\text{Cl}$ proves beyond a doubt that the metal is there tetrabasic.

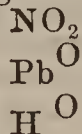
Again: lead is pre-eminent for its tendency to form basic salts even with purely monatomic chlorous elements and radicals. Thus ordinary nitrate of lead, when warmed in aqueous solution with ceruse, expels carbonic acid from that compound, and forms the well-known and crystallisable basic nitrate—



If this be represented upon the water type, it is formed from two molecules of water—



two atoms of hydrogen, one from each molecule being replaced by the biatomic atom lead, whilst one of the remaining atoms of hydrogen is replaced by NO_2 , thus—



But if the binary theory be adopted, it must be represented as lead combined with the radical NO_3 , and also with the radical HO , and the biatomic lead holds thus two atoms together, just as much as biatomic oxygen holds together ethyle and hydrogen in alcohol. If we mix our lead compound with sulphate of silver, and heat with water, we replace the one atom of lead in it by two atoms of silver, getting a mixture of nitrate of silver and brown hydrated oxide of silver, just as the replacement of oxygen in alcohol by Cl_2 forms chloride of ethyle + hydrochloric acid.

We are thus led to consider these metals as biatomic,

and to represent their oxides by the old formulæ CaO , BaO , PbO , whilst carbonates, sulphides, and sulphates have formulæ like CaCO_3 , CaSO_3 , CaSO_4 , their chlorides, nitrates, and phosphates have formulæ like CaCl_2 , $\text{Ca}(\text{NO}_3)_2$, $\text{Ca}_3(\text{PO}_4)_2$. Nitrate of potash has thus a similar formula (NO_3K) to arragonite CO_3Ca , and their isomorphism is no longer surprising. The same remark applies to calc spar and nitrate of soda.

Another analogous group of metals is the triad, magnesium, zinc, and cadmium, all volatile and forming salts which greatly resemble one another, and in many cases isomorphous. The constitution and properties of Frankland's zinc ethyle leaves no doubt of the biatomic character of zinc, for the compound $\text{Zn}(\text{C}_2\text{H}_5)_2$ has the same molecular volume as ether $\text{O}(\text{C}_2\text{H}_5)_2$, and if the atom of zinc were taken out and replaced by one atom of oxygen, there would be no change of volume. Then half the ethyle in zinc ethyle is replaceable by iodine, just as half the ethyle in ether is replaceable by potassium.

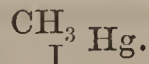
The biatomic character of this family being thus established, we can extend the conclusion to the other metals which form magnesian oxides, so called from the striking analogy of constitution of several of their salts with the corresponding salt of magnesia. In this manner we are led to adopt for iron, manganese, nickel, cobalt, and copper atomic weights corresponding to biatomic characters. The subsulphide of copper is thus represented by the formula Cu_2S , which is sufficiently similar to that of sulphide of silver, Ag_2S , to remove our surprise at their isomorphism. There is, moreover, in the reactions of alumina, sesquioxide of iron, sesquioxide of chromium, and sesquioxide of manganese, much resemblance. All these are weak bases, and their sulphates form with sulphate of potash those most characteristic salts called alums. The three first are isomorphous in the uncombined state, so that the conclusion established for iron and manganese may be extended to aluminium and chromium. But it is also arrived at by other means, for chromium in combination with oxygen and chlorine forms the well-characterised compound CrO_2Cl_2 chloro-chromic acid, which contains the same quantity of oxygen and of chlorine as chloro-sulphuric acid in two volumes of vapour, having 52.5 of chromium in the place of the 32 of sulphur of that compound. Again, chromic and sulphuric acids exhibit a marked resemblance of properties, the former being, if anything, even more distinctly bibasic than the latter, and their normal potash salts are isomorphous, so that chromium is abundantly proved to be similar to sulphur in atomicity, and brings in evidence of its own in favour of the biatomic character of aluminium, iron, and manganese. In like manner manganese in manganic acid is connected with sulphur in sulphuric acid, and requires a corresponding biatomic weight. The isomorphism and general analogy of permanganate of potash with perchlorate of potash has often been alluded to as pointing to the necessity of representing the former by a formula containing one large atom of manganese, MnO_4K : but although this formula, by assimilating the expressions for these two similar bodies, removes one difficulty, it creates at the same time another difficulty, by presenting a formula containing only one atom from the first family of elements. The speaker said he would not at present hazard any opinion regarding the propriety of removing this difficulty by doubling the above formulæ, together with that of perchlorate of potash, although he might remark that the constitution of the basic per-iodate of soda points to the formula $\text{I}_2\text{O}_9\text{Na}_4 \cdot 3(\text{H}_2\text{O})$.

An exceedingly strong ground for admitting for many heavy metals the atomic weight corresponding to a biatomic character was brought forward some time ago by Wurtz, who pointed out that adopting for oxygen the atomic weight 16, we get a half-molecule of water



in one molecule of various salts if we consider the heavy metals monatomic.

Other metals are susceptible of reduction by similar analogies to the class of elements which are biatomic or tetratomic, &c. Thus mercury is proved by the ethylide and methylide to be biatomic by the fact that the compound for one atom of mercury with two atoms of ethyle or of methyle, occupies the same volume in the state of vapour as the compound of one atom of oxygen with two of ethyle or of methyle $\text{Hg}(\text{CH}_3)_2 = 2$ vols., and we can take out one atom of methyle from the bi-methylide of mercury, and replace it by an atom of chlorine, bromine, or iodine without disturbing the type,



The common bi-chloride of mercury has, moreover, a vapour volume corresponding to the biatomic character of the metal, and the same thing holds good of the vapour of metallic mercury itself, which has the same volume as the metal cadmium, and probably zinc, and the well-known biatomic radicals CO , SO_2 , C_2H_4 , but double the volume of the elements oxygen and sulphur. In the present state of our knowledge the speaker was not aware of any sufficient grounds for deciding which of these two constitutions of the free molecule of a biatomic element or radical is to be considered as normal and which is abnormal. On the one hand, mercury, cadmium, and all known biatomic radicals have a molecule containing one atom, while the molecule of oxygen contains two atoms, and that of sulphur two at high temperatures and six at lower temperatures. Selenium is at high temperatures like sulphur. It has been amply shown by Dr. Odling and others that tin is biatomic and tetratomic in its two chlorides, and its compounds with the organic radicals and chlorine, &c., leave no room for doubt on the point.

By similar chains of evidence the remaining metals can be shown to belong to the great biatomic class containing already so many.

The vapour densities of the so-called sesquichlorides of iron, aluminium, and chromium, as determined by Deville, show that the molecule of each of these bodies contains two atoms of metal and six atoms of chlorine, in fact, the same quantity of metal as the molecule of the sesquioxide: this fact has been held to be an anomaly from the point of view adopted regarding their atomic weights. The speaker believed, however, that so far from being anomalous, these vapour densities are the least which can be reconciled with the conclusion that the metals permanently combine with even numbers of atoms from the first family, for if one atom of iron could on occasion combine with three atoms of chlorine to form one molecule, the law respecting it would assume the not very wise form—that iron combines with an even number of atoms from the first family, except when it combines with an uneven number!

The fact is that the sesquichlorides are not exceptions to the law, as at first sight they are suspected of being. Precisely the same remarks apply to the so-called subchloride of sulphur of which the molecule S_2Cl_2 , as required by the law. So also cyanogen C_2N_2 , acetylene C_2H_2 , ethyle, C_4H_{10} , &c., &c. Amongst exceptions, the speaker mentioned nitric oxide and calomel, both of which have vapour densities corresponding to the molecular formulæ NO and HgCl .

Many compounds are known to undergo decomposition on evaporation, and to be reproduced on condensation; thus NH_5O yields the two molecules NH_3 and H_2O , each with its own volume, as also SO_3H_2 yields SO_2 and H_2O . SO_4H_2 and PCl_5 are also known to yield on evaporation vapour corresponding to a breaking-up into two molecules; and there are strong reasons from analogy, as well as experimental evidence, to believe such decomposition. As, however, a high authority seems inclined

to doubt the decomposition, the matter may be considered as still *sub judice*.

The existence of basic salts of mercury or copper, when apparently monatomic, is another class of apparent exceptions to the law. For if, in the sub-nitrate of mercury, the atom of metal really replaced one atom of hydrogen, just as potassium does in nitrate of potash, there ought not to be basic sub-nitrate of mercury any more than a basic potash salt; whereas, if the sub-nitrate of mercury contains, as the speaker asserted, in one molecule two atoms of metal and two atoms of the salt radical of the nitrates (NO_3), then a basic salt is as natural and intelligible a compound as the basic nitrate of the red oxide.

The action of ammonia on calomel confirms the molecular weight Hg_2Cl_2 ; for the compound $\text{NH}_2\text{Hg}_2\text{Cl}$, formed simultaneously with sal ammonia, proves that twice (HgCl) takes place in the reaction.

CANTOR LECTURES.

“On Chemistry Applied to the Arts.” By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE IV.

DELIVERED ON THURSDAY EVENING, APRIL 21, 1864.

ANIMAL FATTY MATTERS, the various processes for liberating them from the tissues in which they are contained. Their composition and conversion into soap. Composite candles. The refining of lard. *Cod-liver*, *sperm*, and other oils. *Spermaceti* and *wax*.

It will be quite out of the question for me to enter upon a general description of the properties and composition of fatty matters, as to do so would be to undertake far too wide a field of research. All that I can attempt in this lecture is to give an idea of their composition, and to describe some of their most recent applications to arts and manufactures.

The question of the source of the fatty matters in herbivorous animals has been the subject of a great number of scientific researches, but those of Baron Liebig, Dumas, Boussingault, Payen, and Milne Edwards have left no doubt that when the food of an animal contains a sufficient amount of fatty matter, this is simply extracted from the food, and stored or consumed according to the animal's habits, that is to say, its consumption is in ratio to the activity of the animal; thus, an animal in a state of great activity is comparatively thin, but when confined in a pen or stall it quickly fattens. These gentlemen also proved that when the food is deficient in fatty matters a portion of the amylaceous or saccharine matter becomes converted into fatty matter. The most decisive experiments on this head were made by Mr. Milne Edwards, who found that when bees were confined under a glass shade, with no food but honey, they converted the greater portion of it into wax. Notwithstanding these proofs, however, chemists found it difficult to understand how substances so rich in oxygen as amylaceous ones become converted into a class of matters containing so little of that element, but Baron Liebig has recently published a paper which has partially solved this problem, showing that animals give off during respiration a larger amount of oxygen than is contained in the air inspired, which excess must be derived from certain organic substances circulating in the blood. Fatty matters may be classed under two heads, viz., vegetable and animal. The first are generally composed of a solid, called margarine, and a liquid, called oleine. The latter generally contains three substances, viz., two solids, stearine and margarine, and one liquid, oleine. I say generally, because there are exceptions; thus, in palm oil palmetine is found, in linseed oil linoleine, in sperm oil spermaceti, and in waxes several peculiar acids. Let us now examine the composition of some of the most abundant fatty matters found in animals. The knowledge of the composition of these substances, of suet for example, was most unsatisfactory until 1811, when my learned and eminent master, M. Chevreul, published his

elaborate researches, by which he demonstrated the real composition of fatty matters in general, and that they might be considered as real organic salts. Thus suet is composed of stearic, margaric, and oleic acids combined with the oxide of glyceryle. The three above-named acids he showed to be composed as follows:—

	Stearic acid.	Margaric acid.	Oleic acid.
Carbon . . .	68	34	36
Hydrogen . .	66	33	33
Oxygen . . .	5	3	3
Water . . .	2	1	1

also that oxide of glyceryle, as it is liberated from the fatty acids, combines with water and forms glycerine. He further showed that when fatty matters were saponified, the change consisted in the substitution, for the oxide of glyceryle, of the oxide of sodium or soda in ordinary hard soaps, of the oxide of potassium and potash in soft soaps, of oxide of lime, baryta, or lead in insoluble soaps. You will easily conceive the pride of M. Chevreul when, forty years later, M. Berthelot effected the synthesis of the fatty matters, the analysis of which M. Chevreul had published in 1811. This he accomplished by heating in sealed tubes, at a temperature of 520° for several hours, one, two, or three equivalents of each of the above acids with one equivalent of glycerine, leaving the mixture to cool, and then boiling it in a vessel with water and lime, when the excess of fatty acids not combined during the experiment were removed by the lime, leaving the neutral fatty matter, which was dissolved by ether, and thus obtained in a state of purity. By this interesting series of researches, M. Berthelot has not only reconstituted neutral fatty matters, but showed that the oxide of glyceryle was triatomic, that is, that one equivalent of the oxide would neutralise three equivalents of the acid, whilst it required three equivalents of soda to produce a neutral stearate with three equivalents of stearic acid.

Stearic acid, $3(\text{C}_{68}\text{H}_{66}\text{O}_5)$, Glycerine, $\text{C}_6\text{H}_8\text{O}_6 - 4\text{HO}$

Stearic acid, $3(\text{C}_{68}\text{H}_{66}\text{O}_5) + 3\text{Soda NaO} - 3\text{HO}$

In fact, the researches of this eminent chemist on the synthesis of organic substances have effected a complete revolution in the last few years in that branch of organic chemistry.

I shall now proceed to give you a rapid outline of the properties of these substances.

Stearic acid is a white crystalline substance, fusible at 158°F. , soluble in alcohol and ether, insoluble in water, and saponified by alkalis.

Margaric acid is a solid crystalline substance, presenting the same properties as stearic, excepting that its fusing point is 140° .

Oleic acid is a fluid remaining in that state even at several degrees below the freezing point of water, and is also soluble in alcohol and ether, but not in water.

Glycerine, or the sweet principle of oils, was discovered in 1779, by Scheele, who extracted it in boiling oil of sweet almonds with oxide of lead, which, combining with the fatty acids, liberated the oxide of glyceryle, and this, in combining with water, formed glycerine. In consequence of the numerous applications of glycerine in medicine, the French have manufactured this substance on a large scale from the liquors in which they have saponified their fatty matters into soap; but the purest and most extensive supply is furnished by Price's Patent Candle Company. In the course of this lecture I will give you a description of its preparation as carried out at their works. Glycerine is a colourless, syrupy fluid, of sweet taste, and sp. gr. 1.28, highly soluble in water and alcohol, combining easily with hydrochloric, hydrobromic, benzoic, tartaric, &c., acids, forming neutral compounds. Diluted nitric acid converts it into glyceric acid; concentrated nitric acid into nitro-glycerine, or a substance exploding with violence by percussion, which has caused it to be proposed as a

substitute for fulminating mercury, by its discoverer, Professor Sobrero. The application in medicine of glycerine has been greatly extended by its highly hygrometric properties. Thus, bandages moistened with glycerine remain constantly moist, because the glycerine attracts moisture from the air as fast as it is lost by evaporation. It has also been found eminently useful in diseases of the eye and ear. Glycerine boils at 527° , but when distilled is partly decomposed into a peculiar oily fluid, of a noxious odour, called acroleine. M. Berthelot has succeeded, by fermentation, in converting glycerine into alcohol. Again, Mr. George Wilson, F.R.S., the talented director of Price's Patent Candle Company, has applied glycerine with great success to the preservation of vegetable and animal substances. Another useful employment of glycerine is its substitution for water in gasometers, where the evaporation of the latter is a source of serious loss. Its addition to a soap solution increases the facility of forming soap bubbles to an extraordinary degree. In fact, by its aid, bubbles of seven or eight inches diameter can be produced, exhibiting most beautiful purple and green colours, the beauty of which is greatly enhanced, as Mr. Ladd will show you, when illuminated by the electric light. To prepare this peculiar soap solution, the following proportions are stated to be employed:—Distilled water, 5 ounces; soap, $\frac{1}{8}$ of a drachm; glycerine, 2 drachms.

The extraction of the fatty matters of animals from the tissues enveloping them is a simple operation. The old process of doing this, technically called "rendering," consisted in introducing the suet into large iron pans and applying heat, which caused the fatty matters, by their expansion, to burst the cells confining them, and to rise to the top of the contents of the boiler, which were left to stand for a few hours, and the liquid fat was then run off. The organic tissues remaining with a certain amount of fat at the bottom of the boilers were removed and subjected to pressure so as to separate the rest of the fat, the organic tissues remaining behind being sold under the name of scraps for feeding dogs, &c. As this operation gives rise to noxious vapours, causing thereby great annoyance, other methods have been generally adopted. For instance Mr. D'Arcet's, the leading feature of which is to place in a boiler say 350 lbs. of suet with 150 of water and fifteen of sulphuric acid, carrying the whole to the boil for some hours, when the sulphuric acid dissolves the organic matters and liberates the fatty ones, which are then easily separated from the aqueous fluid. Mr. Evrard's process appears preferable. He boils the fatty matters with a weak solution of alkali; or, in other words, he uses 300 lbs. of suet with half a pound of caustic soda dissolved in twenty gallons of water, carrying the whole to the boil by means of a jet of steam. Under the influence of the alkali the tissues are swollen and dissolved and the fat liberated. By these operations a better quality of fat is obtained and no nuisance is created. It is found advantageous to purify or bleach the above fatty matters by the following means. Mr. Dawson's process consists in passing air through the melted tallow, and Mr. Watson's in heating melted fatty matter with permanganate of potash. Both these processes, as you will perceive, are based on the oxidation of the colouring organic matter. Some tallow-melters further clarify their tallow by adding 5 lbs. of alum in powder to 100 lbs. of melted tallow, which separates and precipitates any colouring matter. The white snowy appearance of American lard, which is rather deceptive to the eye than profitable, is obtained by thoroughly mixing, by means of machinery, starch in a state of jelly with a little alum and lime, with the fatty matter, by which means two ends are attained—viz., the introduction of 25 per cent. of useless matter, and a perfect whiteness from the high state of division of the same. The fatty matters from fish are generally obtained by boiling those parts of the fish containing them with water, when the fatty matters rise to the surface of the fluid, and one whale has been

known to yield as much as 100 tons of oil. According to M. Chevreul, the composition of whale oil is as follows:—

Solid fats	.	.	{	Margarine,
			{	Cetine,
Liquid fats	.	.	{	Oleine,
			{	Phocénine,

together with a small amount of colouring-matter, and of phocenic acid, which gives to whale oil its disagreeable colour and odour. Many attempts have been made to sweeten whale oil by the use of weak caustic lye, milk of lime, sulphuric acid, and steam; but although a great improvement has been effected, the oil is still recognisable by its unpleasant odour. I have no doubt in my mind, from experiments made by my friend, Mr. Clift, that fish oils might be obtained as sweet as vegetable oils, if proper means for their extraction were adopted. Allow me here to revert to animal fats, to show you that their comparative hardness or solidity, as shown by the following table, depends upon their relative proportions of stearine and margarine, or oleine:—

	Stearine or Margarine.	Oleine.	Melting point.
Ox tallow	. 75 .	. 25 .	. 111°
Mutton suet	. 74 .	. 26 .	. 109°
Hog's lard	. 38 .	. 62 .	. 80°
Butter (summer)	. 40 .	. 60 .	. 86°
Do. (winter)	. 63 .	. 57 .	. 79°
Goose fat	. 32 .	. 68 .	. 79°
Duck fat	. 28 .	. 72 .	. 77°

M. Pelouze proved some years ago that the rancidity of ordinary animal as well as vegetable oils is due to a fermentation; that is to say, that under the influence of the azotised principle associated with all fats, the fatty matters split into their respective fatty acids and glycerine, which in their turn undergo a further change, resulting in the production of volatile fatty acids, such, for example, in the case of butter, as butyric, caproic, capric, and caprolic acids; in the case of goat's milk, hirsic acid; of fish oil, phocenic acid. Further, M. Pelouze demonstrated that in the case of olive oil this change occurred a few hours after the crushing of the berries, the oil thereby coming in contact with the albuminous principles or ferment.

I shall now have the pleasure of calling your attention to some of the special applications which fatty matters receive. The first of these arises out of the action of alkalies upon these substances, the result of which is the conversion of an insoluble matter (oil) into a soluble one (soap). I shall not enter into minute details of this well-known manufacture, but content myself with touching upon some of the most recent improvements. The usual mode of making soap is to add animal fats or vegetable oils to a weak lye, or caustic solution, carrying the mixture to the boil by means of steam-pipes passing through the vessel above a false bottom, and keeping the whole in constant agitation by means of machinery. During this operation the oxide of sodium replaces in the fatty matter the oxide of glycyle, and when the lye is killed, that is to say when all its alkali is removed by the oil, a fresh or stronger lye is added, and these operations are repeated until the manufacturer considers that the matter is nearly saponified, which is easily judged of in practice. He then proceeds with a second series of operations, called salting, which have for their object to separate the glycerine and impurities from the soapy mass, and also to render the latter more firm and compact, in fact, to contract it. This is effected by treating it with stronger lye mixed with a certain quantity of common salt, and allowing it to stand for a few hours, so that the mass of soap may separate from the fluid containing glycerine and other impurities. When the second series of operations are finished the clarifying or finishing process follows: this requires the use of still stronger lye and salt, which not only complete

the saponification, but separate any remaining impurities; the semifluid mass of soap is then allowed to stand for twelve hours, when the soap is either run or ladled into large wooden moulds, and allowed to stand until quite cold. After standing for a day or so, the wooden frame is removed from the solid mass of soap, when it is divided into bars by means of a brass wire. The difference between *white curd* and *mottled* soap is caused by the addition to the fluid mass of soap of about four ounces of alum and green copperas to every 100 lbs. of soap, which gives rise to an alumina and ferruginous soap, which, on being diffused through the mass by means of agitation, mottles or marbles the mass when cool. When well prepared this is the most economical soap, as no large quantity of water can be introduced to weight it, because this would cause the separation of the mottling material from the soap. *Fancy soaps* are prepared in the above manner by the employment of a better quality of materials and the addition of various perfumes. *Rosin or yellow soap*, as its name implies, is one in which a portion of the fatty matters is replaced by rosin, which is added to the soap paste when there is but little aqueous solution of alkali left to dissolve it, so that the rosin can at once enter into the composition of the soap, instead of being dissolved in the alkaline lye and lost. Rosin soaps, nearly white, are now manufactured, owing to the discovery of Messrs. Hunt and Pochin, who have succeeded in obtaining nearly white rosins by distilling common rosin with the aid of superheated steam. *Silicated soaps* are much used in America, owing to their cheapness, which is due to the introduction of a certain amount of silicate of soda. *Transparent soap*, the method of making which was so long kept secret, is now known to be obtained by dissolving soap in alcohol and allowing a concentrated solution of it to cool slowly, when it is poured into moulds and allowed to solidify. One of the most useful and recent improvements in soap-making is that which enables the manufacturer to produce what is called *glycerine soap*, which is characterised by the retention of the glycerine of the fatty matter. Its manufacture only occupies a few hours, instead of several days, as is the case with ordinary soap. It is prepared by employing 63 parts of fatty matter, 33 of water, and 5 of alkali, which are heated to a temperature of between 350° and 400°, for two or three hours, when the mass is entirely saponified, and then has only to run into moulds to be ready for the market. But the most important discovery connected with the saponification of fatty matters by means of alkali is that recently made by M. Mèges Mouries, for this gentleman has arrived at the remarkable result of saponifying fatty matter in the space of twelve hours, and, what is more extraordinary still, at natural temperatures. If we connect this fact with the one that caustic soda is now manufactured by tons, it appears highly probable that in a few years the fatty matters of Brazil and Monte Video, instead of being sent to this country as such, will be converted into soap there, and imported thence by us in that form. M. Mouries has discovered the fact that fatty matters are susceptible, under peculiar circumstances, of being brought into a globular state, and that when in that state they present new and peculiar properties. Thus, for example, fatty matters, when kept in a damp state, usually become rapidly rancid, whilst when in the globular state they may be kept for a very long period without undergoing that change. This peculiar state can be imparted to fatty matters by melting them at 130° and adding a small quantity of yolk of egg, bile, albuminous substances, or, what is best, a solution of alkali, composed of five to ten parts of alkali for every 100 parts of oil, at the same temperature, agitating the whole for some time to bring the fatty matter into a globular condition. If at this stage the action of the alkali is continued and the temperature is raised to 140°, it is found that instead of the fatty matters requiring a long time to

saponify (as is usual even at a temperature of 212°) the saponification is most rapid, because each globule of fatty matter offers an immense surface to the action of the alkali; and it is found that in two or three hours the whole of the fatty matters are converted into soap. In fact, saponification is so perfect that the mass of soap dissolves completely in water; and if the purpose is to liberate the fatty acids, this can be done at once by the addition of a little vitriol. The fatty acids produced by this comparatively cold saponification are so pure that, when subjected to pressure, the solid fatty acids have not the slightest odour, and fuse at the point of 138° . As to the oleic acid prepared by this process, instead of being brown (as is usual with the commercial acid), it is colourless, and can be employed in manufacturing soap of good quality. When M. Mouries desires to make soap with the entire fatty matter, he acts at once upon the globular fatty mass by adding salt, which separates the soap from the aqueous fluid; it is then melted and run into moulds. Whilst speaking of the mode in which alkalies can be made to act upon fatty matters, I ought to state that M. Pelouze observed the curious fact that large quantities of fatty matters could be split into their respective elements, viz., fatty acids and glycerine, by heating them for some hours with a small quantity of soap. This discovery, as we shall presently see, has been taken advantage of in the manufacture of stearic candles.

Permit me to state that *soft soaps* differ from hard soaps mainly in the substitution of potash for soda, and in the omission of the salting and clarifying processes, so that the soapy mass is not separated from the excess of water, and therefore after the fatty matter has been saponified by the alkali, the whole is evaporated to the required consistency. I cannot conclude better this hasty and imperfect sketch of the soap manufacture than by the following table of compositions, showing the percentages of the various elements in the following soaps:—

Names of soaps.	Fatty acids.	Alkali.	Water.
Curd . . .	62	6.0	32.0
Marseilles . . .	60	6.0	34.0
White . . .	60	6.4	33.6
White cocoa . . .	22	4.5	73.5
Yellow rosin . . .	70	6.5	23.5
Calico printers . . .	60	5.2	34.8
Silk boiling . . .	57	7.0	36.0
Wool scouring . . .	55	9.0	36.0
Soft . . .	43	10.0	47.0
Theoretical . . .	63	6.4	30.6

As it is easy to introduce into soaps a much larger quantity of water than they should contain to render their employment economical, it behoves those who use large quantities in their manufacture to ascertain the extent of the moisture contained in soaps. This may be pretty accurately approximated to by placing a quarter of an ounce, divided into thin shreds, upon a hob or other warm situation, and leaving it for several days, when it will lose nearly the whole of the water it originally contained, or about a third of its weight if it does not contain an undue proportion. In many instances the proportions of alkali in soap may seriously affect its applicability. Thus, I ascertained a few years since that the quality of soap best adapted to clear madder purples should not contain more than 5 per cent. of alkali, whilst for pinks, where it is necessary to remove any loose colour which the mordants may have mechanically retained, a more active soap is required—viz., one containing from 6 to 7 per cent. of alkali.

(To be continued.)

LECTURES ON CHEMICAL PHILOSOPHY.—II.

Delivered at the College of France, by M. A. WURTZ. BODIES combine in definite proportions: this is a fundamental law in chemistry. It governs all the questions which agitate the science, and lies at the bottom of all the problems it seeks to solve.

The idea of atoms is the theoretical expression of this law: the notion of equivalents flows directly from it. It is important, then, at starting to establish the precise meaning of the words *atom*, *equivalent*, *molecule*; and to see how these notions, at first ill-defined, and often confounded one with another, have gradually assumed the precise sense we attribute to them to-day.

The notion of equivalents was introduced to science by the remarkable labours of two German chemists—Wenzel and Richter. Setting aside the researches of Wenzel, which are well known, we shall only call attention to some of the numerical results obtained by Richter, from which we may derive some instructive lessons.

Richter, like Wenzel, recognised the proportionality of the quantities of bases which saturate equal weights of different acids, and reciprocally the quantities of different acids which saturate equal weights of different bases. He was led to construct two sorts of series.

The first expressed the quantities of bases which saturate 1000 parts of sulphuric acid, 1000 parts of nitric acid, &c.; the second gave the quantities of acid saturating 1000 parts of potash, lime, alumina, &c.

Although Richter's deductions rest upon less exact analyses than those of Wenzel, he confirmed and generalised upon the law of proportionality propounded by his predecessor. One thing, however, escaped him; he failed to see the inutility of multiplying the series, and that to establish the law it was only necessary to take one, choosing as the term of comparison 1000 parts of an acid or a base—1000 parts of sulphuric acid, for example. This fact, however, was perceived by Fischer, who calculated from Richter's experiments the following series of the *equivalent* quantities of acid and of bases necessary to saturate reciprocally and form neutral salts:—

Bases.	Fischer's numbers.	Exact numbers.	Acids.	Fischer's numbers.	Exact numbers.
Alumina . . .	525	428	Sulphuric . . .	1000	1000
Magnesia . . .	615	200	Hydrofluoric . . .	427	500
Ammonia . . .	672	—	Carbonic . . .	577	550
Lime . . .	793	700	Hydrochloric . . .	712	912
Soda . . .	859	775	Oxalic . . .	755	900
Potash . . .	1605	1177	Phosphoric . . .	979	887
Baryta . . .	2222	1912	Formic . . .	988	925
			Nitric . . .	1405	1350
			Acetic . . .	1480	1275

If we represent 1000 parts of sulphuric anhydride by SO_3 , KO will figure as 1605 parts of potash, BaO as 2222 parts of baryta, and the compounds of each of these bases with SO_3 , may be written SO_3KO , SO_3BaO .

If we represent 1000 parts of sulphuric acid by SO_3 , the quantity of alumina which combines with it will be represented by the formula alO , in which O represents an amount of oxygen equal to that contained in KO.

The formulæ alO and KO , SO_3alO and SO_3KO , represent their equivalent quantities, according to Richter and Fischer. We usually, however, represent sulphate of alumina by $3\text{SO}_3, \text{Al}_2\text{O}_3$. We multiply the equivalent of each body by 3. Here is an anomaly—an inconsistency introduced into the equivalent notation—an infringement even of the principle of this notation. The real equivalent of alumina is the amount of this oxide which will saturate SO_3 ; but this quantity, which we represent by alO , is only equal to one-third of the quantity indicated by Al_2O_3 . The true equivalent formula of sulphate of alumina is then in this respect SO_3alO . Richter was not mistaken. A similar remark applies to the equivalent which he has given for phosphoric acid. The true equivalent of this acid is the quantity which saturates an equivalent of oxide RO; that is to say, one-third of PO_5 , and not PO_5 which saturates 3RO . In fact, the quantity of phosphoric acid which saturates 3 molecules of oxide of silver cannot be equivalent to the quantity of acetic acid which saturates 1 molecule of oxide of silver.

Let us pass now to the equivalents of the simple bodies, taking, for example, 35.5 of chlorine.

35.5 of chlorine combine with	1 of hydrogen to form	ClH
" " "	8 of oxygen "	ClO
" " "	39 of potassium "	ClK
" " "	23 of sodium "	ClNa
" " "	$9\frac{1}{3}$ of alumina "	Clal
" " "	28 of iron in ferrous chloride }	ClFe
" " "	$18\frac{2}{3}$ of iron in ferrichloride }	Clfe

All the numbers 1, 8, 39, 23, $9\frac{1}{3}$, 28, $18\frac{2}{3}$ are equivalents in relation to chlorine. Iron combining with chlorine in 2 proportions we represent the two equivalents by Fe and fe. Instead of formulating the perchloride of iron and of alumina by Al_2Cl_3 and Fe_2Cl_3 , which is not correct, we express them by Clal and Clfe.

The formulæ Al_2Cl_3 and Fe_2Cl_3 are not equivalent formulæ; they represent *molecules*, and are founded upon the atomic notation. Al_2 , for example, represents 2 atoms of aluminium, Cl_3 3 atoms of chlorine, and Al_2Cl_3 represents the smallest amount of that body which can exist free.

The atomic theory we owe to the labours of Gay-Lussac. Dalton was the author of the atomic *hypothesis*. He supposed that the definite proportions, and the multiple proportions, in which bodies combine with each other, represent the relative weights of atoms, small masses indivisible by chemical force, of a fixed value for every sort of matter, and which are joined together in compounds. When a body, A, combines in several proportions with another body, B, it is several atoms of A which are joined to a single atom of B.

This idea of atoms, revived from Leucippus and Epicurus, is merely an hypothesis—a theoretical conception, which does not admit of experimental demonstration. We may remark, further, that the atomic weights of Dalton only represent the proportions in which bodies combine with and replace each other in compounds—that is to say, equivalents. The true atomic theory originated from the experiments of Gay-Lussac on the volumetric relations, according to which gases combine with each other.

We know that 1 gr. of hydrogen unites with 8 grs. of oxygen to form 9 grs. of water, and that two volumes of hydrogen unite with one volume of oxygen to form two volumes of the vapour of water. If we represent 1 gr. of hydrogen by H, and 8 grs. of oxygen by O, the formula HO will represent the proportions by weight in which the two bodies are combined in 9 grs. of water; the formula H_2O , then, is the equivalent formula of water. This is the formula of Dalton.

The atomic theory, on the contrary, supposes that the *volumetric proportions* 2 and 1, according to which oxygen and hydrogen combine, represent the *atomic proportions*, that is to say, the relations between the number of atoms. The *volumes* represent the *atoms*, and thus the relative weights of the volumes of gas, or their *densities*, represent the *atomic weights*.

Berzelius adopted these ideas, and constructed upon them a new system of formulæ. If two volumes of H combine with one of O, it is two atoms of H, which combine with one of O, and consequently the formula of water, he said, ought to be H_2O . Attributing to oxygen the atomic weight 100, he was led to represent the atomic weight of hydrogen as 6.24. Analogous considerations served him to fix the atomic weights of several other gaseous bodies. Chemical analogies, as well as the data relative to the specific heat and isomorphism, served as the basis of the determination of the atomic weights of other bodies. With four exceptions we still employ the atomic weights as determined by Berzelius; in the cases of lithium, sodium, potassium, and silver, we halve the numbers of Berzelius. Why? The study of some important physical laws will show us the reason.

(To be continued.)

ACADEMY OF SCIENCES.

July 18.

M. CH. SAINTE-CLAIRE DEVILLE forwarded some reflections *à propos* to the memoirs of M. Debray on the dimorphism of arsenious and antimonious acids.

M. H. Sainte-Claire Deville contributed a note "*On the Passage of Gas through Homogeneous Solid Bodies.*" The author has continued his experiments on the passage of hydrogen through the walls of wrought iron tubes. His method is well known to our readers. A wrought-iron tube filled with nitrogen is placed in a porcelain tube, through which a current of hydrogen is passed. Upon observing the pressure on the inside and on the outside of the iron tube, it is found that that of the interior may become almost double that of the exterior, in consequence of the hydrogen permeating the walls of iron, and adding its pressure to that of the nitrogen. Unless the temperature is very high no nitrogen passes out, but at very exalted temperatures the author remarked that the internal and external pressures became equalised in consequence of the inter-molecular spaces becoming so much dilated as to allow the nitrogen to pass freely. M. Deville conceives that if we knew the law of the dilatation of these inter-molecular spaces we might determine the relative size of the molecules of hydrogen and nitrogen.

When the pressure in the interior of the tube has reached its maximum, the author analyses the mixture of gases and calculates the pressure of each, and finds that at very high temperatures the pressure of hydrogen within is very much greater than without. We give one example:—

External pressure of hydrogen.	Internal pressure of mixture.	Percentage of H. in mixture.	Calculated pressure of hydrogen.
760 mm.	1851 mm.	64.8	1200

This result is at variance with all the known facts relating to the diffusion of gases, and can only be explained either on the supposition that in the interior of the tube the mixture acts like homogenous matter—an explanation difficult to admit in the present state of science, or by supposing that the result depends upon the fact that in the interior the gases are motionless, while on the exterior the hydrogen is in movement. If this latter explanation be the correct one, the author says he may draw from the facts important consequences in support of the mechanical theory of heat, and some new ideas on the constitution of gases and Graham's hypothesis. He intends, however, first to attentively consider the conditions of the experiment, some of which may have escaped him.

So much attention was excited by his first discovery, that we may announce that M. Boucher de Perthes has been digging again at Moulin-Quignon, and has turned up another jaw and a skull.

The aërolite which fell at Orgueil still attracts the attention of French chemists, and M. Pisani has made an analysis, and proved the presence of soluble hyposulphites.

M. F. Margueritte communicated a note "*On the Carburation of Iron by Contact on Cementation.*" The object of the note is to show that iron is converted into steel by contact with carbon without the intervention of nitrogen. The author experimented with diamonds (instead of charcoal) in an atmosphere of chemically-pure hydrogen, and in vessels absolutely impermeable to the gases from the furnace.

MM. Riche and Bérard presented a note "*On the Bromated Compounds of Benzol and its Homologues.*" The authors have formed bromated compounds of benzol, xylol, cumol, and cymol. With regard to the last, they remark that cymol made from camphor does not appear to form the same derivatives as that from oil of cumin.

NOTICES OF BOOKS.

A Dictionary of Chemistry, and the Allied Branches of other Sciences, &c. By HENRY WATTS, B.A. London: Longman and Co. 1864. Parts xvi. and xvii.

THIS valuable work continues to be regularly issued, and we need hardly say that the articles are kept up to the standard of excellence which distinguishes this dictionary from all of the kind which have preceded it. The two numbers we now notice contain articles on hydrogen, indigo, iodine, and the commencement of one of great interest on iron.

Journal für Praktische Chemie. Edited by O. L. ERDMANN and G. WERTHER. Nos. 10, 11, 12.

THE first of these numbers contains a long article by Dr. J. Websky on the formation and composition of peat, the interest of which is not in proportion to the length.

Dr. Spigatis gives an account of a resin obtained from the root of *Ipomœa turpethum*. It appears to be a drastic purgative, and, like Convolvulin and Jalapin, to be a glucoside. The composition, moreover, according to Dr. Spigatis, is the same as that of the two bodies just named. The author has given the name *turpethin* to the resin. When boiled with dilute sulphuric acid it splits up into sugar and an acid body, to which the author has given the name *turpetholic acid*.

Dr. Buchner publishes a *Contribution to the History of Berberin*, correcting Mr. Dyson Perrins on a few unimportant matters.

The same author describes an *Ethereal Oil obtained from the Fruit of the Pinus Regiæ Amaliæ*. This oil is closely allied to turpentine, but possesses some peculiar properties. It ozonises air much more strongly than oil of turpentine, and dissolves iodine freely without decomposing. It forms also a staple compound with hydrochloric acid. As a remedy it may be used wherever the employment of turpentine is indicated, and, indeed, it is to be preferred on account of its more agreeable smell.

R. Hermann contributes some *Researches on Cerium*; they are confined to the oxides and the red and yellow sulphates.

H. Werther continues his *Contributions to the Knowledge of Thallium*. The author describes the hyposulphite of soda and thallium, silicofluoride of thallium, double sulphates of nickel, zinc, iron, and magnesia, and thallium, and appends analyses of all these compounds. He also gives some determinations of the solubility of iodide of thallium in water and spirit, the former differing somewhat from our own results. We shall return to this paper on a future occasion.

The same author gives an account of the formation of dithionic or hyposulphuric acid in a hitherto unobserved way. It seems that when selenium is treated with an alkaline sulphite a selenide of the alkali and a hyposulphate are formed, *e.g.*—



Number 11 opens with a series of papers by Schönbein, of which we now give only the titles, most of them deserving a full abstract on a future occasion. The first is entitled, Some Views on Hydrosulphurous Acid; 2. On a new and highly-sensitive Reagent for Peroxide of Hydrogen and Nitrites; 3. A Contribution towards a more intimate knowledge of Human Urine; 4. On the Formation of a Fluorescent Material by the Decomposition of Human Urine; 5. On the Occurrence of Peroxide of Hydrogen in the Human Body. It will be seen that all these papers are of great interest.

A paper, by Dr. Herman Grothe, "On the Behaviour of Solutions of Metallic Oxides towards Alkalies in the Presence of some Non-volatile Organic Bodies," shows that many metallic oxides are not precipitated by alkalies

when tartaric or citric acid or sugar is present in the solution. This fact is not unknown to our readers, but the author has extended his experiments to some which we believe have not before been noticed in this relationship.

Dr. Bothe gives a simple method of *silvering glass in the cold way*, which we shall give at length in an early number.

Gustav Reichert describes a double salt of nitrate with chloride of silver— $\text{AgONO}_5 + \text{AgCl}$.

The remaining papers are translations of articles which have already appeared in abstract or at length in the CHEMICAL NEWS.

CORRESPONDENCE.

Continental Science.

PARIS, July 28, 1864.

THE good and learned Abbé Moigno deserves the thanks of his numerous friends in this city for having introduced an innovation at his last lecture on the Progress of Science during the month, in the hall of the Société d'Encouragement, which cannot fail to be adopted, in hot weather at least, by all *entrepreneurs* of public meetings or entertainments. Instead of being illuminated by the innumerable jets of gas with which the hall is provided, a single electric light, placed in a central position, lit the room in the most perfect manner. The consequence was that, although the thermometer was above 100° out of doors, no one was inconvenienced by the heat, and although there were nearly 500 persons present, hardly a single pocket handkerchief was used as a *sudarium* during the meeting. While enjoying the comparative coolness, one could not help thinking of the summer evening meetings of the London Chemical Society, held in the hottest and worst ventilated meeting-room it was ever my ill luck to enter.

The heat here during the last week has been positively frightful, and forms the only subject of conversation everywhere.

M. E. Kopp announces the discovery of a new chromic salt—the double chromate of potash and ammonia,—which promises, from the facility with which it decomposes under the action of light, to be of the greatest service in photography. The salt is easily made. Strong liquid ammonia is poured on pure bichromate of potash until the whole of the ammonia is neutralised by the second equivalent of chromic acid. A slight excess of the alkali is then added, and the whole is heated and set aside to crystallise under a bell jar, beneath which a few drops of liquid ammonia have been spread. The sensitive surface is prepared in the dark, and is of a light orange colour. Exposure to light turns it to a dark brown. To fix the image it is only necessary to wash the print in some clear water, to which a few drops of hydrochloric acid have been added. M. Kopp regards the image as being composed of the chromate of chromium—*i.e.*, $\text{CrO}_2 = \text{Cr}_3\text{O}_6 = \text{Cr}_2\text{O}_3, \text{CrO}_3$. According to him, therefore, we may change the colour of the print by acting either on the chromic acid or the base. If we choose the former we may use a soluble salt of lead, silver, mercury, bismuth, &c., and afterwards submit the coloured image so formed to the action of sulphuretted hydrogen or a solution of an alkaline sulphide. If we wish to act on the acid which behaves as a mordant to vegetable colouring matters, we may employ solutions of alzarine, purpurine, logwood, Brazil wood, &c. A solution of logwood, and subsequent treatment with chloride of lime, gives a capital effect, almost equal in colour to a gold-toned print.

In the *Journal* of the Belgian Photographic Society M. Von Monckhoven recommends an economical nitrate of silver bath, which, he says, produces results equal to those obtained by using the ordinary proportions of that very expensive salt. He dissolves 16 grammes of *pure* nitrate of soda and 8 grammes of nitrate of silver in 100

grammes of water (about 70 grains of nitrate of soda and 35 grains of nitrate of silver to the ounce). To every four ounces of solution add three drops of nitric acid. If the albumen is disturbed, add two or three more. The paper must be fumigated with ammonia before use in the ordinary manner, taking care not to continue the process too long, or the paper will turn brown. The toning and fixing of the print is performed in the usual manner. M. Von Monckhoven also gives another process, in which oxide of silver is dissolved in nitrate of ammonia, but it so closely resembles that devised by M. Hardwich that it will not be necessary to give it.

In the *Photographischer Archiven*, M. Obernetter recommends a concentrated solution of perchloride of iron as a detergent for silver stains on the hands or clothes. If gallic or pyrogallic acid has been used, it will be necessary to wash the spot afterwards with a few drops of a strong solution of oxalic acid. A weak solution of this salt is also useful for diminishing the intensity of negatives to be copied in the solar camera. Weak negatives may be transformed into strong ones by using first a solution of chloride of iron, and secondly with pyrogallic acid and nitrate of silver.

Relations between Equivalents.

To the Editor of the CHEMICAL NEWS.

SIR,—In your impression of the 2nd inst. a correspondent, under the name of "Studiosus," has called attention to the existence of a law to the effect "that the atomic weights of the elementary bodies are, with few exceptions, either exactly or very nearly multiples of eight."

Now, in a letter "On Relations among the Equivalents," which was signed with my initials, and inserted in the CHEMICAL NEWS of February 7, 1863, I called attention to the numerical differences between the equivalents of certain allied elements, and showed that such differences were generally multiples of eight, as in the following examples:—

Member of a Group having Lowest Equivalent.	One immediately above the Preceding.	Difference.	
		H=1	O=1
Magnesium 24	Calcium 40	16	1
Oxygen 16	Sulphur 32	16	1
Lithium 7	Sodium 23	16	1
Carbon 12	Silicon 28	16	1
Fluorine 19	Chlorine 35.5	16.5	1.031
Nitrogen 14	Phosphorus 31	17	1.062
Lowest Term of Triad.		Highest term of Triad.	
Lithium 7	Potassium 39	32	2
Magnesium 24	Cadmium 112	88	5.5
Molybdenum 96	Tungsten 184	88	5.5
Phosphorus 31	Antimony 122	91	5.687
Chlorine 35.5	Iodine 127	91.5	5.718
Potassium 39	Cæsium 133	94	5.875
Sulphur 32	Tellurium 129	97	6.062
Calcium 40	Barium 137	97	6.062

In the last of the above columns the difference is given referred to 16, the equivalent of oxygen, as unity, and it will be seen that, generally speaking, the equivalent of oxygen is the unit of these differences, just as the equivalent of hydrogen, in "Prout's law," is the unit of the atomic weights. Exceptions there are, however, in both cases which render it necessary to take one half or one quarter of the equivalent of oxygen in the one case, and of hydrogen in the other, in order to represent all the numbers obtained as multiples by a whole number of the given standard.

Now, if the law of "Studiosus" had any real existence, the above facts would resolve themselves into particular cases of its application. For if "the atomic weights are

multiples of eight," any differences between them must also be divisible by eight.

We have here the symbols and the atomic weights of sixty-one elements, placed in their numerical order, and in the third column is the difference between each atomic weight and the one immediately preceding it:—

H . 1	Ca . 40	1	Ce . 92	2.5	V . 137	0
Li . 7	Ti . 50	10	La . 92	0	Ta . 138	1
G . 9	Cr . 52.5	2.5	Di . 96	4	W . 184	46
B . 11	Mn . 55	2.5	Mo . 96	0	Nb . 195	11
C . 12	Fe . 56	1	Ro . 104	8	Au . 196	1
N . 14	Co . 58.5	2.5	Ru . 104	0	Pt . 197	1
O . 16	Ni . 58.5	0	Pd . 106.5	2.5	Ir . 197	0
Fl . 19	Cu . 63.5	5	Ag . 108	1.5	Os . 199	2
Na . 23	Y . 64	0.5	Cd . 112	4	Hg . 200	1
Mg . 24	Zn . 65	1	Sn . 118	6	Tl . 203	3
Al . 27.5	As . 75	10	U . 120	2	Pb . 207	4
Si . 28	Se . 79.5	4.5	Sb . 122	2	Bi . 210	3
P . 31	Br . 80	0.5	I . 127	5	Th . 238	28
S . 32	Rb . 85	5	Te . 129	2		
Cl . 35.5	Sr . 87.5	2.5	Cs . 133	4		
K . 39	Zr . 89.5	2	Ba . 137	4		

Now, it will be observed that in all the above differences the number eight occurs but once, and we never meet with a multiple of eight, whereas if the law of "Studiosus" were true the equivalents of the elements, in whatever order they might be placed, should, when not identically the same, differ either by eight or by some multiple of eight in every case.

While upon the subject of "relations among the equivalents," I may observe that the most important of these may be seen at a glance in the following table:—

		Triad.			
		Lowest term.	Mean.	Highest term.	
I.	Li 7	+17 = Mg 24	Zn 65	Cd 112	Au 196
II.	B 11				
III.	C 12	+16 = Si 28		Sn 118	+88 = Bi 210
IV.	N 14	+17 = P 31	As 75	Sb 122	
V.	O 16	+16 = S 32	Se 79.5	Te 129	+70 = Os 199
VI.	F 19	+16.5 = Cl 35.5	Br 80	I 127	
VII.	Li 7	+16 = Na 23	+16 = K 39	Rb 85	Cs 133
VIII.	Li 7	+17 = Mg 24	+16 = Ca 40	Sr 87.5	Ba 137
IX.			Mo 96	V 137	W 184
X.			Pd 106.5	Pt 197	

This table is by no means so perfect as it might be; in fact, I have some by me of a more complete character, but as the position to be occupied by the various elements is open to considerable controversy, the above only is given as containing little more than those elementary groups the existence of which is almost universally acknowledged.

I now subjoin a few explanatory remarks on the different groups contained in the above table, the number attached to each group being merely for the purpose of reference.

Group II.—Boron is here classed with gold, both these elements being triatomic, although the latter is sometimes monatomic.

Group III.—Silicon and tin stand to each other as the extremities of a triad. Titanium is usually classed along with them, and occupies a position intermediate between silicon and the central term or mean of the triad, which is at present wanting; thus,

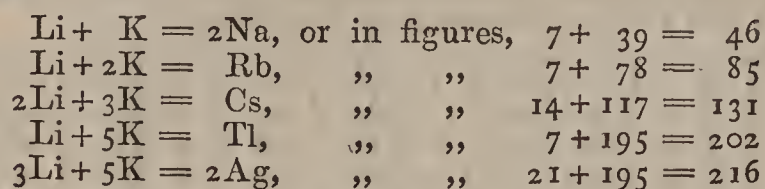
$$\frac{\text{Si } 28 + \text{Sn } 118}{2} = 73, \text{ mean of triad, and}$$

$$\frac{\text{Si } 28 + \text{Mean of triad } 73}{2} = 50.5, \text{ the eq. of Ti being } 50.$$

Group IV.—The equivalent of antimony is nearly the mean of those of phosphorus and bismuth; thus,

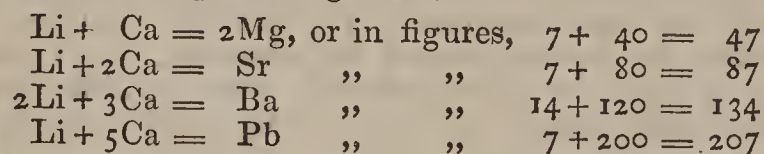
$$\frac{31 + 210}{2} = 120.5, \text{ the eq. of Sb being } 122.$$

Group VII.—The relations which M. Dumas has pointed out between the members of this group are well known; a slight alteration must be made, owing to the atomic weight of caesium having been raised. The relations, then, will be thus:—



The equivalent of silver is thus connected with those of the alkali metals. It may also, which amounts to the same thing, be viewed as made up of the equivalents of sodium and rubidium, thus, $23 + 85 = 108$. It is likewise nearly the mean between rubidium and caesium, thus, $\frac{85 + 133}{2} = 109$.

Group VIII.—If lithium may be considered as connected with this group as well as with the foregoing (and by some chemists its oxide is viewed as a connecting link between the alkalies and the alkaline earths), we may perform the same calculations in this group that M. Dumas has done in the preceding, thus,—



Again, there are two triads in the group of alkali metals, one which has been long known—viz., lithium, sodium, and potassium, and the other, which was pointed out by Mr. C. W. Quin, in the CHEMICAL NEWS of November 9, 1861—viz., potassium, rubidium, and caesium. Potassium is thus the highest term of one triad and the lowest term of another.

In like manner, if we include lithium, we shall have among the metals of the alkaline earths two triads, the first comprising lithium, magnesium, and calcium, and the second calcium, strontium, and barium, calcium standing at the top of one triad and at the bottom of the other.

The element lead occupies a position in relation to the metals of the alkaline earths similar to that filled by thallium in the group of alkali metals. Osmium appears to play a similar part in the sulphur group, and bismuth in the phosphorus group. The analogous term in the chlorine group is not yet known.

Thallium, in its physical properties, bears some resemblance to lead, and it frequently happens that similar terms taken from different groups, such as oxygen and nitrogen, or sulphur and phosphorus, bear more physical resemblance to each other than they do to the members of the groups to which, for chemical reasons, we are compelled to assign them.

It will be observed that the difference between the equivalents of tellurium and osmium, caesium, and thallium, and barium and lead, respectively, is the same in each case—viz., 70.

Group X.—Palladium and platinum appear to be the extremities of a triad, the mean of which is unknown.

So frequently are relations to be met with among the equivalents of allied elements, that we may almost predict that the next equivalent determined, that of indium, for instance, will be found to bear a simple relation to those of the group to which it will be assigned.

In conclusion, I may mention that the equivalents I have adopted in this letter were taken from the highly-interesting and important paper by Professor Williamson, lately published in the *Journal of the Chemical Society*.

I am, &c.

JOHN A. R. NEWLANDS, F.C.S.
Laboratory, 19, Great St. Helens, E.C., July 12.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Notices to Proceed.

592. Edward Bishop, Headingley, near Leeds, and William Bailey, Halifax, Yorkshire, "Improved means and apparatus for evaporating the water contained in the faecal or excrementitious matter."

597. John Thomas Way, Leadenhall Street, London, "Improvements in the manufacture of manure from woollen rags, mixed woollen and cotton rags, shoddy, or waste wool."—Petitions recorded March 9, 1864.

639. Thomas Parkinson and Francis Taylor, Blackburn, and Thomas Burton, Padiham, Lancashire, "Improvements in machinery and apparatus for sizing, dressing, dyeing, and drying."—Petition recorded March 14, 1864.

801. James George Beckton, Whitby, Yorkshire, "Improvements in engines or machinery for forcing, blowing, or exhausting the air and other gaseous fluids."—Petition recorded March 31, 1864.

926. Auguste Andigier, Rue Grignan, Marseilles, France, "Embalming and mummyfying dead bodies."—Petitions recorded April 13, 1864.

MISCELLANEOUS.

Trial of Gun-Cotton at Moor Edge Farm.—Mr. Winship's farm, at the Moor Edge, was on Saturday morning last the scene of an interesting trial of the powerful explosive nature of the gun-cotton prepared according to the Austrian process by Messrs. Thomas Prentice and Co., of Stowmarket, Suffolk. The engineering arrangements were conducted by Herr Reve, C.E., assisted by Dr. Richardson, Mr. Harcastle, of Newcastle, and Mr. Prentice. At the low end of the field, a military stockade, consisting of six heavy piles of the best Memel wood, about 10 feet long, firmly fixed into the ground to about 4 feet, the openings being backed up with five timbers 9 inches square. In front of the stockade was, in military parlance, a bridge of two timbers 14 inches in diameter, resting on sleepers 1 foot from the ground, on which the explosive shell, of a cylindrical construction, was laid, leaning against the piles. The shell contained 25 lbs. of gun-cotton. About a quarter to one all the preliminaries were completed, when the company, who had been previously engaged in minutely examining the stockade, were requested to go to the top of the field to be out of danger. The "destructable" was then fired by electricity at a distance of 220 yards from a heavy battery placed at this distance from the stockade. Immediately the electric spark reached the machine the explosion occurred; the heavy pieces of timber were soon flying about in all directions, and that which the moment before appeared strong enough to withstand the assault of the enemy was a perfect wreck. Two of the centre piles were literally chopped off to within a foot of the ground; and the other four were removed out of their position to an angle of 170 degrees, one being carried to a distance of 130 yards, leaving a clear space of about 5 feet for the advancing enemy to rush through. The timbers forming the bridge on which the shell was laid were both broken in the middle, and were removed between 30 and 40 yards. The shell itself was broken into atoms, and scattered in all directions.—*Northern Daily Express*.

ANSWERS TO CORRESPONDENTS.

A Reader.—Alcoholate of zinc, $\left. \begin{array}{c} 2\text{C}_2\text{H}_5 \\ \text{Zn} \end{array} \right\} \ominus_2$, is formed by the slow oxidation of zinc ethyl.

P. H.—We think it has been described in the *Philosophical Transactions*.

P. F. P.—Dry at 112°, and preserve it in well dried and stoppered bottles; there is no other way.

R.—Received with thanks.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Origin of Graphite.—Reports of M. HAIDINGER and others.

IRON, after remaining long buried in the earth, at last entirely decomposes, leaving a black, porous, eminently combustible residuum, known as graphite or pure carbon. M. Haidinger's report on the ferruginous masses of Kokitzan and Gotta, near Dresden, masses of uncertain origin, lends support to this general fact.

One word on the formation, still so little known, of graphite (plumbago pencil lead). The presence of graphite in granite, gneiss, and diorite, has renewed the disputes between the Neptunists and Plutonists. Graphite is well known to be nearly pure carbon, for it leaves in burning but a very small quantity of ash. Now, if these primitive crystalline rocks are of igneous formation, it is impossible to explain how graphite could co-exist with silicates of protoxide of iron without having reduced these salts. Judging merely by what takes place in blast furnaces, carbon reduces all oxides of iron at a high temperature. It must, then, be admitted that granite, gneiss, and diorite did not contain graphite when the mineral elements of these rocks, such as mica, hornblende, and other ferrous silicates were in a state of fusion. Graphite, then, must have been subsequently introduced into these rocks—but when, and how? Questions such as these are very difficult to answer satisfactorily. The most plausible hypothesis is that graphite has been introduced by the wet way into the crystalline rocks and substituted for one of the mineral components. Thus in the gneiss of Passau (Bavaria) it takes the place of mica.

Graphite is frequently to be met with in granulated limestone—a fact particularly interesting to geologists. Is limestone a product of eruption, or is it a sediment transformed by the action of heat? The presence of graphite is explicable by neither hypothesis. For at a certain temperature, which need not be very high, carbon decomposes carbonate of lime. This salt may, no doubt, under strong pressure, be heated to the melting point without losing its carbonic acid; this is a laboratory experiment often cited by the Plutonists. But it is quite a different thing with a mixture of carbon and carbonate of lime at a high temperature. If we reject the Neptunian origin of granulated limestone, we must then, as with crystalline rocks, suppose that graphite has been introduced by the wet way at a more recent period. The same remark applies to magnetic pyrites (sulphide of iron), often very rich in plumbago kernels.

Does graphite, like all carbon, belong to the organic kingdom? It is certain that anthracite, lignite, coal, are the result of the slow decomposition of an enormous quantity of vegetables; the impressions found on them often indicate the kind of vegetables, most of them extinct, which have contributed to these carbonaceous formations. Graphite, if not formed in precisely the same way as coal and anthracite, nevertheless bears signs of an organic origin. The formation of nuclei and veins of graphite in crystalline rocks is sufficiently explained by the decomposition of carbonised hydrogen gas at a high temperature; this gas, disengaged from organic matters, and penetrating the fissures of the burning rock, would undergo decomposition into hydrogen and carbon.

It is this deposited carbon which forms graphite. If in our laboratories we do not obtain exactly the same product it must be remembered that Nature has means

at her command which escape our researches. We find it impossible to make coal from wood. The wood may be carbonised by the dry or by the wet way. In the first case the carbonisation is very rapid; in the latter it is extremely slow, as is shown by the blackened points of piling sunk in water.

Finally, graphite has been found in meteorites or areolites. Attempts have been made to explain its presence here by the continuance of these stones in soil more or less rich in carbonised principles. But with regard to newly-fallen stones this explanation is inadmissible. If it be maintained that graphite is an organic product, it must be admitted that in the case of newly-fallen meteorites it can proceed only from organic matters belonging to another world than our own.

In his report on Alibert graphite M. Dumas presents some considerations on the probable origin of graphite and of the diamond. M. Despretz and others ascribe to fire the change of carbon into diamond; Newton ascribed it to the coagulation of a fatty or oily body; Liebig says the diamond is slowly formed by processes which determine the prolonged putrefaction of a liquid body rich in carbon and in water; then, contrary to M. Despretz's method, a high temperature would be unfavourable to a successful attempt. Adopting Newton's hypothesis, M. Gœppert states, in a "memoir on the solid bodies entering into the composition of the diamond, and considered with regard to their organic or inorganic origin," that he is disposed to class the diamond among the products of the decomposition of organic matters. All these hypotheses M. Dumas rejects; according to him the diamond is crystallised carbon, at the moment of its production and in the midst of a mass which has been exposed merely to the heat necessary to soften it, provided this condition is sufficiently prolonged.

Finally, M. Dumas frankly admits that nothing positive is known as to the true origin of the diamond, though the substance most allied to it, silicium, is perfectly known, and very beautiful crystals of it are obtained.

However, it is positively ascertained that the diamond and graphite have not the same origin, and that the residue of every carboniferous substance, treated at a high temperature, proves to be but a variety of graphite. The new carbon found by M. Alibert in the mines of Marinski, situated at the summit of Batougol, on the Siberian frontiers, is, then, a graphitoid carbon of the most beautiful kind, formed by volcanic phenomena. M. Jaquelain, after carefully comparing the external characteristics of Alibert graphite with that obtained by his process, concludes that the conditions under which they are produced must be analogous.

In fact, on comparing the texture of the two carbons, they will be found sometimes of a metallic, mirror-like lustre; at another time the surface will be of shining steel-grey, mammillated as if it had been half fused, and had passed through a pasty stage. This appearance is similar to that of oxide of iron, nodulous brilliant, with mammillated surface, known by the name of brown hematite.

M. Jaquelain is inclined to admit that tarry and pyrogenated products, transformed in immense proportions into carbon and hydrogen, under the influence of igneous rocks, become accumulated in rents and excavations, causing an aggregation of carbon, and inducing a fusion analogous to that of carbon in retorts for lighting gas, and of graphitoid carbon destined to form the pencils used for the electric light.

On this point M. Jaquelain narrates one of his own

recent experiments. On decomposing some sulphide of carbon in a porcelain tube in presence of pure copper, heated to about 800° , sulphite of copper and graphite were formed, externally similar to natural graphite.—*Cosmos*, pp. 720—725, 1864.

PHARMACY, TOXICOLOGY, &c.

*On the Active Principles of the Strychnaceæ,**
by F. F. MAYER, New York.

THE literature, medicinal, pharmaceutical, and chemical, of the drugs derived from this family is by no means as extensive as that of opium and of bark, nor is our knowledge of their active principles as accurate as might be expected or desired.

These active principles are supposed to be represented by two or three alkaloids, which, named in the order of discovery, are strychnia, brucia, and igasurina. Pelletier and Caventou, in 1818, discovered in the ignatia seed a bitter alkaloid, which they named *Vauqueline*, in honour of the great pharmacist; this name Bucher, sen., considered inappropriate, and proposed in place of it *Strychnin*, which it thenceforth retained. *Tetanin* was suggested for it by Magendie. Pelletier and Caventou likewise found this alkaloid in nux vomica and bois de conleuvre, snake wood, lignum colubrinum, from *strychnos colubrinum*. Shortly after they noticed the existence of a different alkaloid in the bark of *Strychnos nux vomica*, then known as false angustura bark, and supposed to be that of *Brucea antidysenterica*, hence its name of Brucia, in place of which Geiger once proposed caniramin (*canis* dog, *ira* rage). Desnoix, lastly, noticed a crystalline deposit in the alkaline liquor from which strychnia and brucia had been precipitated, and called the same *Igasurina*. Schutzenberger afterwards confirmed that this alkaloid concurred in many properties with brucia, but found it was itself a mixture of no less than nine different bases, varying slightly in the percentage of carbon, hydrogen, and oxygen, and water of crystallisation as well as in solubility. The same chemist had before noticed similar variations in the composition of strychnia. It is readily perceived from the properties ascribed to strychnia, especially, and brucia, by Pelletier and Caventou, Pettenkofer, Geiger, and Merck, that these chemists operated with mixtures of the alkaloids. For this reason statements as to the quantity of the respective alkaloids to be found in either nux vomica or ignatia seed, made previous to Wittstock, are not to be relied on. The latter observer states that 10 ozs. of nux vomica yield $12\frac{1}{2}$ grains of strychnia and $31\frac{1}{4}$ of brucia, while, according to Gieseler, 10 ozs. of ignatia seed yield 72 grains of strychnia. Pelletier and Henry obtained between 40 and 50 grains of this impure strychnia from 10 ozs. of nux vomica.

These discrepancies find their explanation in the peculiar character of that portion of the alkaloids which is not readily precipitated by alkalies.

The alkaloid which received the name of strychnia is recorded as scarcely soluble in water and alkalies. Planta, whose observations will in most cases be found at least as trustworthy as those of others who are much more frequently quoted, never uses the expression "insoluble" in such cases, but says "not perceptibly soluble;" and this, as a matter of course, is the case with all alkaloids, since none of them are never completely insoluble in water, or completely precipitated by alkalies proper. Brucia was called originally the pre-

cipitate which falls down from mother liquors of crystallisations of strychnia by the addition of more soluble alkali, and igasurina that which finally deposited from the alkaline solution on standing. With the exception of Planta, who mentions the difficulty with which brucia is precipitated by ammonia, I find on record but one instance in which the circumstance is mentioned which enables one, without entering more closely into a consideration of the subject, to give a rapid as well as accurate method for determining strychnia in the presence of the other alkaloids; it is this,—in a paper published by that excellent chemist Dr. F. L. Winchler, of Darmstadt, in 1835, *Repertorium f. de Pharmacie*, Bd. li. p. 369—wherein he mentions the solubility of brucia in ammonia and caustic alkalies and earths, and determines the quantity of brucia in the alkaline mother liquor from the precipitation of strychnia by acidulating, and then precipitating it with corrosive sublimate.

It might be supposed that, as this solubility is considered a characteristic of igasurina solely, this alkaloid or mixture of alkaloids was identical with brucia, and that there were, in fact, but two alkaloids present in the plants of one family. But there is a considerable degree in this solubility; a portion of the dissolved alkaloid crystallises out; while the remainder, which, however, forms a crystalline salt with oxalic acid, is held indefinitely long in solution.

Strychnia itself is, to some extent, soluble in alkaline liquids. As the proper alkali for experiments and assays of this kind, I have long since used and recommended in a particular instance crystallised caustic baryta, which, in my opinion, cannot be surpassed by any other substance of this class. My remarks in this connection have, therefore, exclusive reference to precipitation and solution by means of caustic baryta.

100 c.c. of a solution of baryta at 60° F. dissolve 0.036 of a gramme, or 0.55 of a grain of strychnia.

100 c.c. of the same solution of baryta dissolve as a minimum 0.5 gramme, or nearly eight grains of brucia.

In determining the strength of a preparation from a drug containing these alkaloids, it is only necessary to know the quantity of a reagent required for the sum of the alkaloids, to precipitate a known portion of the solution made from the preparation by baryta, and to dilute the alkaline liquor to a certain strength sufficient to hold in solution all the brucia which may be present.

A gramme of pure strychnia requires for precipitation 59.88 c.c. of one-tenth normal solution of iodide of mercury, provided the strength of the solution does not exceed one-half of one per cent. The precipitate produced differs in its composition from that yielded by other alkaloids, inasmuch as it contains two equivalents of mercuric iodide to one of hydriodate of the alkaloid. The quantity of one-tenth normal silver solution equivalent to 59.88 c.c. of mercury solution is 239.52 c.c.; of the eight equivalents of iodine and chlorine contained in the 59.88 c.c. mercurial solution, three of iodine, or three-eighths, are absorbed by the alkaloid, and there is consequently a deficiency of three-eighths of the number of the cubic centimetres of the silver solution—i.e., to precipitate the filtrate from the mercurial precipitate of one gramme of strychnia, only 149.7 c.c. of silver solution are required.

A gramme of pure brucia requires 42.9 c.c. of mercurial solution, and the composition of the precipitate is analogous to that of the strychnia compound, and to that of the combinations of mercuric chloride with strychnia and brucia. It is also necessary that the brucia solution be dilute, and contain no more than half per

* *Proceedings of the American Pharmaceutical Association.*

cent., but rather less, of the alkaloid. In this case there consequently will be a deficiency of 64.35 c.c. of silver.

Of the troy weight solution of iodide of mercury, containing 16 and two-ninths grains of corrosive sublimate and 69 grains of iodide of potassium in 12½ troy ounces, every 10 grains correspond to 0.0334 of a grain of strychnia, and 0.0466 of a grain of crystallised brucia.

With these data the subjoined assays have been made, exhibiting the relative strength of the officinal preparations from nux vomica and ignatia seed, and the proportion of strychnia and the alkaloids soluble in water and alkalies which I have classed as brucia.

1. *Six ounces powdered nux vomica, exhausted by displacement with 80 per cent. alcohol.*—The tincture was evaporated on the water bath with a little hydrochloric acid to the consistence of treacle. While still warm it was mixed with 50 c.c. of cold water, and the fatty substances allowed to separate by standing; the whole was then filtered, and with the washings diluted to 100 c.c.

20 c.c. of these required for precipitation 21.5 c.c. of mercurial solution, the 100 c.c., or 6 ounces, therefore 107.5 c.c. Hg.

20 c.c. were then given in a 75 c.c. flask, diluted with water to 75 c.c., and then shaken with crystallised caustic baryta in excess. After filtering the alkaline solution, 40 c.c. of it was acidulated with hydrochloric acid, and then precipitated by the mercurial solution; they required 10.3 c.c., or 19.3, for the 75 c.c.—20 c.c. original solution. These 75 c.c. hold in solution strychnia equivalent to 1.63 c.c. mercurial solution, which, deducted from 19.3, leaves 17.67 c.c. as the equivalent of brucia, or 88.35 c.c. in the six ounces. The latter number deducted from the original 107.5 c.c., leaves 19.15 c.c. as the equivalent of strychnia.

The six ounces of nux vomica exhausted by alcohol of 80 per cent., therefore contain—

31.75 grains of brucia,
4.69 „ strychnia.

2. *Six ounces of the same powdered nux vomica exhausted with boiling alcohol of 80 per cent., acidulated with hydrochloric acid.*—The tincture from this was treated in precisely the same manner. The fatty substance contained more fluid oil.

They were found to contain—

26.7 grains of brucia,
8.57 „ strychnia.

3. *Tincture of nux vomica*—

225 c.c. contain 2.93 grains of strychnia,
„ 19.5 „ brucia.

4. *Extract of nux vomica*—

5 grammes contain 2.46 grains of strychnia,
„ 7.75 „ brucia.

5. *Extract of nux vomica (Ph. Boruss)*—

4.6 grammes contain 0.7715 grains of strychnia,
„ 13.1155 „ brucia.

6. *Semen ignatiæ, 2 ounces displaced with alcohol (80 p. c.)*—

Yielded 4.93 grains of strychnia,
„ 9.86 „ brucia.

7. *Semen ignatiæ (the same) 2 ounces extracted with alcohol and hydrochloric acid*

Yielded 4.5 grains of strychnia,
„ 13.73 „ brucia.

8. *Extract: Ignatiæ alcohol, 8.15 grammes*

Yielded 4.93 grains of strychnia,
„ 8.42 „ brucia.

PHYSICAL SCIENCE.

On Some Physical Properties of Eugenic Acid, by CHARLES TOMLINSON, F.C.S.

It must be regarded as a curious circumstance that certain liquids of small solubility display some of the motions and other phenomena of camphor on the surface of water. This was first pointed out by Mr. Tomlinson in the case of creosote, and recently in the case of eugenic acid ($C_{10}H_{12}O_2$), which displays the phenomena in question in a remarkable manner.

When a drop of eugenic acid is placed on the surface of two fluid ounces of distilled water in a glass capsule two and a-half inches in diameter, it forms a cohesion figure, consisting of a flattened disc of about $\frac{2}{10}$ ths or $\frac{3}{10}$ ths of an inch in diameter, which sails about on the surface of the water with a vibrating motion of the edge, not nearly so vigorous as the disc of creosote under similar circumstances. The eugenic acid disc often splits up into two or three discs, which revolve round each other, and as they become smaller, move more rapidly, and at length disappear in wild gyrations. The manner in which the disc is disposed of by solution is by throwing off a number of films in rapid succession, which are taken up by the water nearly as fast as they are formed. In this way a repellant action exists all round the disc, which action is at first tolerably equal in all directions, but by exposure to the air certain points of the edge of the disc become resinified, and cease to give off films. These points thus becoming inert assist in the generation of a remarkable series of currents, which set out from the active portions of the disc, and return by a kind of indraw to the inert portions. These currents are often visible by means of the oxidised portions of the films left on the surface, or may be made still more striking by dusting a little lycopodium powder over the surface. A few grains of the powder falling at the edge of the disc will produce physically inert points, and thus assist in the generation of the currents.

Eugenic acid is so little soluble in water, that supposing the first drop to be disposed of in ten minutes in two ounces of water, a second drop may last an hour, a third drop upwards of two hours, while a fourth drop may remain a couple of days on the surface. The time, however, varies with the age of the acid; when newly distilled, it is a little more soluble than when it has been kept some time.

As in the case of the camphor motions, the eugenic acid is more vigorous on a large surface than on a small one, with the same quantity of water. In like manner also anything which diminishes the adhesion of the water checks or arrests the rotations. The currents are very feeble on a solution of common salt or in water containing a little sulphuric acid. The action of small portions of oil in arresting the motions of eugenic acid is the same as in those of camphor. A fixed oil forms a permanent film, and prevents adhesion; a volatile oil, such as turpentine, arrests the motions of the eugenic acid disc only while it is evaporating, or if newly distilled, does not arrest them at all, the eugenic acid skating on the water through the turpentine film, and back again indifferently.

The action of the repellant films given off by the eugenic acid disc is well shown when other films, such as those of turpentine, are placed on the surface. A drop of turpentine gently delivered from the end of a glass rod to the surface on which the eugenic acid disc

is floating about, will flash out into a film so as completely to cover the surface, except that part of it occupied by the eugenic acid disc, and a small annular space round it. The eugenic acid disc is struck motionless, but in a few minutes it resumes its activity, invades the turpentine film, and cuts its way through it in all directions. A drop of oil of cubebs does not form a film, but only a flattened disc, in the presence of the eugenic acid disc; the latter, however, soon invades it, drives it about, dashes through it, and disperses it. A drop of oil of bitter almonds is similarly treated.

In the case of the camphor motions, evaporation is as important a function as solution. If the vessel be covered up, or the experiment be conducted in a bottle, the camphor motions and the lycopodium currents produced by the films as they are disengaged in rapid succession, immediately cease. The eugenic acid rotations and currents, on the contrary, can be produced in a covered vessel, and even in a corked bottle, showing that solution is the chief function in the production of these motions. The eugenic acid disc, as soon as it comes in contact with the water, disengages by the adhesion of the water an invisible film, which surrounds the disc, and exerts a repellant action in all directions. This film immediately enters into solution, and gives place to other films, which are similarly disposed of. It is the liberation of this annular film which prevents oils from touching the disc, and produces the repulsion of the lycopodium powder. The first disc of acid is got rid of in this way, and the adhesion of the water is so far impaired that soon after the second drop is placed on the surface the disc forms round it, not an annular film, but portions only of a film, which radiate from the disc in broad lines, *a, b, c* in the figure. Moreover, the



second drop being exposed to the air so much longer than the first, partial resinification sets in at two or more points in the circumference, producing the conditions favourable for the apparent attraction and repulsion of the particles; for if *E* be the disc, and *a, b, c* the portions of film given off by it before entering into solution, and *r, r*, the resinified points, the radial portions *a, b, c* drive the particles of lycopodium into the tranquil spaces, *t*, where they get dragged into the currents *s, s*, by which they are carried forward in the direction of the arrows. If particles of lycopodium fall on the edge at *r, r*, they serve to make those points of the disc inert, and so assist the indraw of the particles towards them. We may also consider the radial portions *a, b, c* as being raised above the general surface, in which case, the surface water being driven away, other surface water must flow in to supply its place, and

dragging with it the powder, will produce the apparent attractions. The powder often rotates in complete circles or eddies—an effect produced by the particles tending to sink into the lower water by the side of a current that tends to carry it forward; these are just the conditions required for the formation of an eddy.

The currents circulate with considerable rapidity, and are seen in their highest perfection with eugenic acid. They may be noticed feebly if a drop of oil of cloves or of oil of Jamaica pepper be placed on water, and dusted with lycopodium.

King's College, London.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE IV.

DELIVERED ON THURSDAY EVENING, APRIL 21, 1864.

ANIMAL FATTY MATTERS, the various processes for liberating them from the tissues in which they are contained. Their composition and conversion into soap. Composite candles. The refining of lard. Cod-liver, sperm, and other oils. *Spermaceti* and wax.

(Continued from page 56.)

I have now to draw your attention to a totally different kind of manufacture—viz., that of composite, stearic, and Belmont candles. Many years elapsed between the scientific discovery by M. Chevreul of margaric and stearic acids, and their application to illuminating purposes; for it was early in 1825 that MM. Chevreul and Gay-Lussac took out a patent with a view of realising this advantage. But it was reserved for a manufacturer, M. de Milly, to perfect the manufacturing details of the processes, and to render these candles a marketable commodity. This he effected by also improving the manufacture of the wicks, and he was the first to introduce this article to the trade in 1832, under the name of *bougies de l'étoile*. Let me give you an idea of his *modus operandi*. 100 lbs. of tallow, 17 lbs. of lime previously slaked, and 1000 lbs. of water were placed in a large iron boiler, and kept at the boil for several hours by means of a jet of steam. The result was that the glycerine dissolved in the water, whilst the fatty acids united with the lime. The insoluble stearate, oleate, and margarate of lime were then decomposed by weak vitriol, under the influence of heat. Insoluble sulphate of lime was produced, and the fatty acids liberated. These, in their turn, were submitted to hot and cold pressure, which liberated the oleic acid, leaving the solid stearic and margaric acids behind; it was then only necessary to cast them into moulds containing wicks, and the *bougies de l'étoile* were produced. MM. de Milly and Motard have introduced, of late years, several important improvements into this branch of manufacture, the most important of which is that of operating under pressure, by which means they succeed in decomposing the fatty matters with 3 or 4 per cent. of lime instead of 17, this, of course, involving the saving of a large quantity of vitriol. M. Bouis has made a further improvement by adding to stearic candles 3 or 4 per cent. of sebacic acid, which is extracted from castor-oil, and has the high fusing-point of 261°. M. Chevreul also suggested a simple method of increasing the whiteness of these candles by the addition of a small quantity of ultramarine blue to neutralise the slightly yellow tint of the manufactured acid. One of the greatest improvements in the manufacture of these candles is that carried out by Price's Candle Company; but before describing to you this beautiful process, as adopted by Mr. G. F. Wilson, at this company's works, allow me to state a few facts. Up to 1840 the best kind of candles were those made of spermaceti or of animal fatty matters which

were cold and hot-pressed. In that year Mr. Wilson, whilst experimenting with the view of making candles which would not require snuffing, for the illumination on the occasion of her Majesty's marriage, discovered that a combination of cocoanut stearine with stearic acid would make candles giving a beautiful light, and free from the necessity of snuffing. These he called "composite," and they were soon largely sold. In 1838 M. Fremy published his interesting discoveries, showing that when oils or fatty matters were mixed with 20 or 30 per cent. of concentrated sulphuric acid, the fatty matters were split, or, as he calls it, saponified, and that sulpho-margaric, sulpho-stearic, sulpho-oleic, and sulpho-glyceric acids were formed. He further observed that boiling water decomposed the sulpho-stearic and margaric acids, and only partially the sulpho-oleic into stearic, margaric, oleic, and sulphuric acids, which last acid remains in the water together with the sulpho-glyceric acid and that portion of the sulpho-oleic acid not decomposed, the other acids remaining insoluble and floating on the surface. In 1842 Messrs. G. Price and Jones secured a patent to carry out on a practical scale the scientific discoveries of M. Fremy. In that patent two or three important facts are brought out; first, that if instead of operating at a low temperature, as recommended by Fremy, heat was employed, the action of the sulphuric acid on the organic compounds would give rise to sulphurous acid, which they discovered had the remarkable property of converting the liquid oleic acid into a solid acid called "elaidic," thus largely increasing the yield of solid fatty acids. Their mode of operating was this: 10 or 12 per cent. of concentrated sulphuric acid was added to the fatty matters which had been previously liquefied by heat, and the whole was kept at a temperature of 200° for twenty-four hours. During that time the fatty matters were split into their primitive elements, and the oleic acid was converted into elaidic acid. The whole was then repeatedly treated with boiling water, to dissolve the sulpho-glyceric acid and other impurities, leaving the solid fats ready for distillation. Mr. G. F. Wilson has since then greatly improved this part of his manufacture, as the beautiful candles, everywhere to be seen, will amply prove. The most important improvement in a chemical point of view is the following:—He has found, for example, that fatty matters are split up into their component parts by decreasing quantities of vitriol as the temperature used is increased. Thus, at a temperature of 200°, 15 parts of vitriol are required; at 350°, six parts; at 500° one part. Further, by employing this small proportion of sulphuric acid, not only is the expense of washing the fatty matters after their saponification by the acid avoided, but the distillation may be proceeded with in the same vessel. The distillation of fatty matters, first performed by Mr. Wilson, and since carried by him to a state of perfection, is based on the fact that, whilst fatty matters, if distilled by direct heat, are completely decomposed, giving rise to the noxious vapours of acroleine, from the destruction of the glycerine, &c., this evil is completely avoided in distilling them by passing a current of superheated steam at a temperature of between 550° and 600° through the mass of melted fatty matters previously brought to the same temperature. By this means the glycerine passes first without decomposition, and is then followed by the fatty acids. In fact, the distillation proceeds with such rapidity and regularity that a stranger might witness the distillation of 1000 gallons in twenty-four or thirty-six hours, and all the time would probably suppose that water only was distilling. The results are so perfect, that the Jury at the Paris Exhibition of 1855 could hardly credit their genuineness, and actually deputed Mr. Warren de la Rue to come from Paris to verify the fact that the beautiful products exhibited were obtained in many instances from very inferior kinds of fat. The glycerine only requires redistillation to be fit for all the purposes to which it is

applied. As to the acids, they are submitted to an intense cold pressure, which separates the oleic acid from the stearic, margaric, or palmitic acids. These are melted, and when near the point of solidification, the vessel containing them is run on rails over the moulds which are so arranged that each frame contains 200 separate moulds, in which already the wicks, prepared with borax or a salt of ammonia, are fixed. The only remaining operation is to fill the moulds and allow the candles to cool.

Oleic acid has recently been made available for several valuable purposes; it has been largely employed in the manufacture of soap; but its most important application as yet is its use on the Continent, and recently in England, as a substitute for olive oil in the greasing of wool for spinning, the advantages of which are marked, as its removal by alkalies in the scouring process is much easier, and its price lower. Messrs. Laing and Wilson have recently taken out a patent for the employment of oleate of ammonia as a mordant; and, as the specimens which I have the pleasure to show you illustrate, it increases in a marked manner the beauty and brilliancy of the coal-tar colours on cotton.

It now only remains for me to refer to another interesting process for splitting fatty matters into their elements, I mean that of M. Tilghman, which consists in mixing fatty matters with one-third to one-half of their bulk of water, and placing them in a vessel capable of resisting a very high pressure. They are submitted to a temperature of between 550° and 600° Fahr., and under the influence of that heat and pressure the fatty matters are decomposed into glycerine and fatty acids. M. Tilghman has also adapted an apparatus which enables him by means of coils of tubes to keep up a constant stream of fatty matters and water through the tubes surrounded by fire, by which means the decomposition is rapidly and continuously carried on. I must not, however, conclude this part of my lecture without drawing your attention to these beautiful specimens illustrating the manufacture of Messrs. Price and Co., kindly lent to me by Mr. G. F. Wilson.

Spermaceti.—This valuable substance is found in large quantities in the bony receptacles of the head of the white whale of the South Seas, and as it is there mixed with a fluid substance called sperm oil, these are separated by means of filtration. The solid mass which is thereby left in the linen bags is first pressed cold, and then between heated plates (hot-pressed). It is then physicked, or heated in a boiler with a solution of caustic potash of specific gravity 1.45, which dissolves a small amount of oily matter, still adhering to the spermaceti, and this, after being well washed, is run into moulds to cool. The manufacture of spermaceti candles requires great care and practical experience. The only fact I shall mention is, that about 3 per cent. of wax is added to spermaceti to prevent the mass being too crystalline or brittle. M. Chevreul, who chemically examined pure spermaceti, or cetine, at the beginning of this century, succeeded in unfolding it into an acid, which he called ethalic acid, very similar to palmitic, and into a neutral substance called ethal, the composition of which, he prognosticated, would be found to contain pure alcohol. This, I am pleased to say, has proved to be the case; for its composition can be considered as represented by—
$$C_{32}H_{53}O_3 + HO.$$

Mr. Heintz has recently published a very elaborate paper on the composition of this substance, and states that spermaceti contains the following components:—

		Ethal or oxide of cetyl.
Stearophanate ..	$C_{76}H_{123}O_3$	$C_{22}H_{35}O_3$
Margarate ..	$C_{24}H_{39}O_3$	..
Palmitate ..	$C_{32}H_{51}O_3$	..
Cetate ..	$C_{30}H_{49}O_3$	..
Myristate ..	$C_{28}H_{45}O_3$	..
Create ..	$C_{26}H_{43}O_3$	..

It appears to me that several of these products do not exist ready formed in spermaceti, but are the results of chemical reactions.

Bees' Wax.—I have already had the pleasure, at the commencement of this lecture, of drawing your attention to the fact that bees either gather wax from the flowers on which they alight, or are capable of producing it direct from saccharine matters. The wax as it is obtained from the honeycomb being coloured, it is necessary to bleach it for most of the applications which wax receives. The old process (still followed in many parts of Europe) consists in melting wax in water, and allowing it to run into a second vessel, so as to separate it as completely as possible from its impurities. When cooled to nearly its melting point, it is allowed to fall on rollers which revolve in cold water, by which means thin ribbons of wax are obtained, which are then placed on meadows to bleach under the influence of the atmosphere. The above operations are repeated until the wax is perfectly bleached. This plan is so tedious and expensive that several chemical processes have been proposed. M. Casseraud's is, to pass steam through the melted mass, which is, at the same time, subjected to the influence of sun light. Mr. Solly's is, to treat the melted wax by a mixture of nitrate of soda and sulphuric acid, when the nitric acid liberated oxidises and destroys the colouring matters of the wax. Pure wax melts at 149° , and, when treated with alcohol, is found to be composed of—

Cerine or cerotic acid ..	$C_{54}H_{53}O_3HO$..	65
Myricine ..	$C_{92}H_{92}O_4$..	30
Ceroleine ..	..	5
		100

Sir Benjamin Brodie, who examined most minutely the chemical composition of a great variety of waxes, considers that the substance called by chemists cerine is really cerotic acid, and that myricine is a compound of palmitic acid and melissine. The lecturer here illustrated and explained the various adulterations of wax, giving the means of detecting them. The adulterations were common owing to its value.

Chinese Wax is a compact substance, imported from China, and said to be secreted by an insect called *Coccus Pela sinensis*. This wax, which is harder and more brittle than bees' wax, melts at 181 , and has yielded in the hand of the above eminent chemist, cerotic acid and cerotine, or oxide of cerotyle.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. PERCY, F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.

LECTURE XII. (Last of the Course).—Saturday, January 30.

LADIES AND GENTLEMEN,—The subject of our lecture to-day is volcanoes, but it is not my intention to present you with any general description of those marvellous and sublime exhibitions of natural forces. No branch of geology is more impressive or more instructive than that which has for its object the study of the results and causes of volcanic activity. In the short space of an hour it would not be possible to enter even upon the threshold, so to speak, of this vast subject. Admirable, comprehensive, and, I may add, thrilling descriptions of active eruptions and their attendant phenomena will be found in many treatises on geology, of which I may especially mention the "Principles" of Sir Charles Lyell. I propose on the present occasion to direct your attention to certain chemical points relating to volcanic action, which, in their bearings upon geological science, will, I trust, prove not unacceptable to you, notwithstanding it will be necessary to cite the results of numerous analyses and of various chemical reactions which do not admit of illustration by striking and attractive experiments on a lecture table.

I must rely solely on the intrinsic interest of the subject, and, ladies and gentlemen, I shall do so with confidence.

The elements which chiefly compose the solid matters ejected from volcanoes are oxygen, silicon, aluminium, iron, calcium, magnesium, sodium, and potassium. You will remember that most of these we have passed in review. The other elements are—(I speak now of those which have been clearly detected by chemical analysis)—zirconium in the form of zircon, as in lava at Vesuvius; lithium in a certain variety of palagonite, and of this rock we shall have to speak at length by-and-by;—I give this on the authority of Waltershausen;—boron in the state of boracic acid, in the crater of Vulcano in the Lipari Islands, and also evolved with steam in the fumeroles of Tuscany; chlorine, the chief constituent of the products of sublimation; fluorine, existing in certain volcanic minerals; phosphorus in the lavas of Etna in cavities as phosphate of protoxide of iron, which appears to have been derived from the oxidation of finely-diffused phosphide of iron—at least, such is the theory put forth to account for its presence there; arsenic as realgar—subsulphide of arsenic in the crater of Vulcano, and in the Solfataras; selenium in minute quantity in an orange-coloured variety of sulphur from the crater of Etna; sulphur in all craters, and in the Solfataras; manganese and titanium nearly always, in combination with iron in lavas and volcanic ashes; copper in minute quantity generally; it occurs sometimes in the beautiful form of tenorite in crystalline scales of protoxide; nickel, with traces of cobalt, in olivines; chromium, stated to have been detected in small quantity in a variety of palagonite, vanadium, in minute quantity, but distinctly in an Iceland chlorite. Traces of zinc are reported to have been found in certain sublimed products in Monte-Rosso. Tin has been discovered in the crata of Etna; lead as galena in the rock of Monte Somma, and as chloride of lead in the crater of Vesuvius, and also in sublimed products of Monte-Rosso in combination with protoxide of copper and traces of silver. The elements evolved in the state of gas will be presently enumerated.

According to Bunsen, notwithstanding the great diversity in the mineralogical characters and chemical composition of the rocks of Iceland, all the eruptive masses there, from the most ancient to the most recent, consist either of one or two typical minerals or rocks, or of various mixtures of these two—namely, what he terms the normal trachytic and the normal pyroxenic. On these points I must beg your most particular attention. It leads to a wide and, it may be, a very important generalisation. All these rocks, then, he maintains, may be reduced to two typical rocks, or to various mixtures of these rocks—that is to say, any rock analysed, if not composed of one or the other may be represented by definite mixtures of these two rocks. That is the point. From the result of numerous analyses the mean composition of these rocks was found to be this,—

	Normal trachytic.	Normal pyroxenic.
Silica	76.67	48.47
Alumina and protoxide of iron	14.23	30.16
Lime	1.44	11.87
Magnesia	0.28	6.89
Potash	3.20	0.65
Soda	4.18	1.96
	100.00	100.00

You see that what Bunsen designates as the normal trachytic rock is rich in silica, the proportion being large. The opposite extreme, or that which is poorest in silica, is the pyroxenic. You see how much larger the proportion of alumina and iron is in this case. This rock is especially rich in lime. Magnesia is also in large quantity. The ratio between the oxygen of the silica and that of the bases in the first series—the trachytic type—is as 3 to 0.596. The ratio of the oxygen of the silica to that of the bases

in the normal pyroxenic is as 3 to 1.998, or very nearly 2. Although there are other unaltered rocks of Iceland, or non-metamorphosed rocks, in the composition of which none of these ratios exist, yet it may be shown notwithstanding that in all these rocks the oxygen in the bases ranges from 0.579 to 1.948 for every three of oxygen. I wish you to understand that point clearly. It may be shown that the oxygen of the bases ranges between the numbers which I have placed before you. This is done by a very simple calculation: from the ultimate composition of any of the unchanged Icelandic rocks, the proportions in which the trachytic and pyroxenic rocks should be mixed to agree with that composition is very readily deduced. Numerous varieties of these rocks have been analysed by Bunsen, and he assures us—and his analyses prove what he says—that there is not one in which the results differ from the calculated composition to a greater extent than might reasonably be expected in such a calculation based merely on the mean results of analyses.

This general induction applies also to the rock formations upon the lava streams of the Icelandic volcanoes. The typical rocks and the rocks resulting from their intermixture exist in these most modern formations. The blackish-grey stony lava of which he speaks on the south eastern foot of the Krafla, and the beds of obsidian alternating within it, have exactly the same composition as the normal trachytic mass.

	Stony lava.	Obsidian.
Silica	75.12	75.28
Alumina	11.34	10.22
Protoxide of iron	3.92	4.24
Lime	1.73	1.81
Magnesia	0.39	0.25
Potash	1.85	2.44
Soda	4.39	5.53
Water	0.41	0.23
	100.00	100.00

These two analyses—that of the stone-like lava and the vitreous lava or obsidian—when placed side by side, agree so exactly that you would be inclined to suppose that the analyses referred to the same specimens. The analysis I have given of the trachytic rock very nearly represents the composition of these two kinds of lava. The streams of obsidian on the north-eastern declivity of Hecla approach very nearly in composition to that which I have stated, and may be represented as composed of 1 part of the trachytic rock to 0.2325 of the normal pyroxenic. We now pass on to the typical pyroxenic rock, or the extreme basic rock—that which contains the least silica and the most base. This is represented in the substance of the great lava streams which flow west-north-west from Hecla to the banks of the Thjórsá. The composition found by analysis is nearly identical with that of the normal pyroxenic type. The lavas from the western foot of Hecla may be represented as composed of mixtures of these two typical rocks in the following proportions:—

	Trachytic.	Pyroxenic.
Lava at Hals.	1	2.77
Efrahoals lava	1	1.568
Ash of Hecla from the eruption, 1845	1	2.402

The order which is here given is that of the succession of the streams examined, from the more ancient to the younger. Hence it is inferred by Bunsen that “the flow from the two volcanic foci which maintained the activity of the volcano is as irregular as the activity itself.” He extends his induction beyond the limits of Iceland, and in proof of its correctness adduces the results of analyses of non-metamorphosed volcanic products from various parts of the world. From a special investigation of the volcanic system forming the high table-land of Armenia, he concludes that the matters composing these rocks have flowed from sources chemically identical with those of

Iceland; and he suggests the idea that all the volcanic formations on the earth’s surface have originated from chemically-identical sources. This is a very large induction, and it requires a vastly greater number of experiments to justify our unqualified reception of it.

The subject we have next to consider is the volcanic tufa, or “tuff,” as it is commonly called. It is defined by Sir Charles Lyell as “an Italian name for a variety of volcanic rock of an earthy texture, seldom very compact, and composed of an agglutination of fragments of scorice and loose materials ejected from a volcano.” The tuff is the result of the greater or less degree of agglutination of volcanic ash. In Iceland the so-called palagonite tuff is stated to be the most ancient of the volcanic series there. Its formation was immediately followed by the elevation of trachyte and clinkstone, or, as it is termed, phonolite, from the ring which it gives when struck. Then comes the penetration of the older amygdaloidal trap, which appears in large veins far extending laterally through the tuffaceous masses. Next, the olivine and basaltic masses penetrated the trap formations in systems of veins of different ages. The series of plutonic elevations, it is stated, closes with the fifth period of the older or more recent lavas.

The mineralogical characters of palagonite, which is recognised as a distinct mineral species, may be stated to be the following:—“Its colour varies from amber-yellow to colophany brown; it is inferior in hardness to calcspar, and it is amorphous in structure.” The palagonite tuff is composed of silicates decomposable by acids, and of others which are not so decomposable. These consist chiefly of augite and a difficultly-decomposable felspar, or a mixture of both, resulting from fusion, and forming trap or basalt. The fragments of basalt are sometimes a foot in diameter, and sometimes so small as even to be invisible to the naked eye. Occasionally small crystals of felspar or green or black augite are found in it, and the so-called sidero-melan of Waltershausen, which occurs in small globules, and may be regarded as nothing more than a fused, highly-ferriferous variety of felspar termed labradorite. The composition of felspar may be represented, according to Bunsen, by the formula—



The RO represents the lime series of bases—lime, magnesia, protoxide of iron, potash, or soda. You will recognise in the first part of the formula ($3\text{RO}, 2\text{SiO}_3$) our old friend Wollastonite. The term R_2O_3 represents alumina, the alumina being partially replaced, it may be, by peroxide of iron. This substance of the alumina series is in combination with silica, forming a silicate, the oxygen of the base being equal to that of the acid. It is important to note this formula especially. Perhaps you would like to have a record of one analysis of palagonite, so I will give it. A great number of analyses of it from different localities have been made, which you will find recorded in Waltershausen’s work on “Volcanoes,” and also in Rammeisberg’s “Dictionary of Mineral Chemistry,” both in German. All the analyses are there collected.

Analysis of Iceland Palagonite by Bunsen.

Silica	37.417
Peroxide of iron	14.175
Alumina	11.165
Lime	8.766
Magnesia	6.036
Potash	0.685
Soda	0.652
Water	17.152
Insoluble residue	4.108
	100.156

This rock is derived entirely from metamorphic action. Please to note the fact that the iron compound is the peroxide, and not the protoxide. This singular cementing

rock, palagonite, is, as you see, a hydrated compound, containing about 17 per cent. of water.

The palagonite tuff consists of a mixture of anhydrous and hydrated silicates. It is asserted that the anhydrous silicates—those free from water—belong exclusively to the pyroxenic rocks, and are never accompanied by trachytic masses, or even replaced by them. The hydrated silicates which generally cement together the fragmentary rock may be regarded as a mixture or combination of two silicates, one of which has the formula, $3\text{RO}, 2\text{SiO}_3 + \text{Water}$, and the other of which has the formula, $\text{Al}_2\text{O}_3\text{SiO}_3$. The palagonite substance appears to occur everywhere as a characteristic constituent of tuff when the pyroxenic rocks are especially well developed. It is met with in the more considerable basaltic elevations of Germany and France, on Etna, in the Azores, in the Galapagos Islands, the Cape de Verde Islands, and elsewhere. Bunsen gives analyses of the palagonite, or the cementing matter of the tuff, from various parts of Iceland, from which it appears that the composition is very uniform, the oxygen of the alumina series of bases being about half that of the silica, and the oxygen of the lime series of bases being about half that of the alumina. Analyses of palagonite occurring in the Cape de Verde Islands, the Azores, the Canaries, and in the basaltic formations of Germany, led to the same result. Its composition is deduced from a great variety of analyses. Several analyses of the material from various parts of the world lead to the conclusion that its composition may be precisely represented as a hydrated pyroxenic rock. That is a very curious and important chemical fact. Bunsen arrived at the conclusion that a palagonite substance may result from the action of lime on pyroxenic rock at a high temperature. He cites the observation of Darwin on basaltic lava which had run over a recent deposit of limestone. The product of this mutual action is described as a breccia-like conglomerate, in which the altered lava is mixed with a very pure mass of carbonate of lime. The mixture, he says, had the appearance of having been kneaded in a pasty state, which, according to Bunsen, excludes the possibility of supposing that fragments of the limestone accompanying the lava had originated from subsequent infiltration. "The chemical change," he says, "which has resulted from the contact of the limestone with the lava does not leave any doubt as to the nature of the process by which the palagonite has been formed. Wherever the lava is in contact with the limestone it is converted into a mass presenting all the mineralogical characters and chemical reactions of palagonite; and this metamorphism, characterised by a gradual transition into the unaltered rock, is more fully developed where the calcareous substance preponderates over the constituents of the mass." We shall examine this theory directly. An analysis is then given to show that the metamorphosed lava scarcely differs in composition from palagonite. He tells us that he has been able to recognise perfectly analogous though not identical relations by observation and experiment on basaltic dykes traversing limestone. Then he mentions tuffs from various and remote localities, which, he maintains, prove in the most decisive manner that palagonite may be generated as I have described. He actually produced palagonite by heating basalt in molten potash, when hydrogen was evolved, owing to the peroxidation of the protoxide of iron existing in basalt at the expense of the oxygen of the water. When steam at a high temperature is brought in contact with this rock the protoxide of iron is peroxidised by the oxygen of the steam, and hydrogen in equivalent proportion is liberated. Bunsen also obtained palagonite by igniting an intimate mixture of one part of finely-powdered basalt and thirteen parts of slaked lime, and elutriating or washing the product, which consisted of a mixture of lime and palagonite; and this palagonite was recognised under the microscope by its peculiar charac-

teristics. Here, then, is apparently experimental proof of the foundation of this rock in the laboratory by heating a mixture of basalt and slaked lime; but Bunsen is obliged to admit that lime cannot have been an agent in the formation of most palagonites, especially this of Iceland, because carbonate of lime scarcely ever occurs as a constituent of the undecomposed palagonites of Iceland, and because the percentage of lime in the mineral itself calculated as anhydrous does not equal the percentage of the same constituent in the normal pyroxenic rocks. He is, therefore, driven to the assumption that fixed alkalis, and not lime, were the agents of the transformation—an assumption which involves another, namely, that there existed a third kind of normal volcanic rock abounding in an alkaline base. This is a pure assumption, one assumption being required to explain the other. Admitting the assumption that the palagonite might have been formed in that way, he thinks that the alkali may have been volatilised from the supposed rock "while in a state of igneous fusion," and, as an argument in support of this, he adduces the fact of the volatilisation of potash in our iron-smelting furnaces; but I submit that this is not the simple case of separation of potash from its combination with silica by the mere action of heat. In the blast furnace there is a large excess of an extremely fixed base, namely, lime, which has a tendency to combine with silica and displace the potash, and under these circumstances it is in nowise difficult to account for the volatilisation of the potash. I am not aware that it has been shown that silicate of potash, rich in silica, has been decomposed by heat alone. In the blast furnace there would be not only lime present, but also alumina. I maintain, therefore, that the illustration drawn by Bunsen from what occurs in our blast furnaces cannot occur in these natural phenomena. In the localities referred to by Bunsen no such conditions have been shown to obtain, or can obtain. With reference to the alleged action of lime I would ask, even if the limestone were there to supply the material, is it conceivable that intermixture in any sensible degree of the bases with viscid lava could possibly take place? Bunsen's laboratory experiment of heating one part of finely-powdered basalt in intimate mixture with thirteen parts of slaked lime, was made under circumstances which it is certain could never have been approximately imitated in nature. He has, therefore, failed to present us with any more satisfactory foundation for his views concerning the formation of palagonite than mere assumptions which seem to be an absolute contradiction to the phenomena observed in nature. Waltershausen entertains the opinion that palagonite has been formed on the bed of the sea, on which volcanic ash has subsided. He lays stress on the comparatively large proportion of magnesia contained in palagonite, and accounts for this by the action of the magnesian salts of the sea-water.

Let us next direct our attention to the gases evolved by volcanic action. A prodigious evolution of gaseous matter, or vaporous matter, or both, takes place from volcanoes in activity, and a very large proportion of these matters is certainly steam, or the vapour of water. The nature of the exhalations cannot, of course, be ascertained directly, but must be inferred from that of the gaseous matter which we are able to collect, and which escapes under conditions differing very much in degree from those which obtain during active volcanic operations, or, in other words, during the process of eruption. Gas is evolved from what are called volcanic vents or fumeroles, which are often so small as to be imperceptible. "Fumeroles" is the common expression by which these vents are designated now-a-days. "Gas springs" we may term them. They become visible by the condensation of the aqueous vapour or steam which comes out, or by the precipitation of sulphur in a minutely-divided state, or by the deposition of other solid or liquid matter which

may have been carried upwards from other subterranean recesses. The gases of volcanoes have been investigated by Bunsen, by Charles Sainte-Claire Deville (brother of the aluminium Deville), and by Leblanc. They have devoted special attention to the study of the composition of volcanic exhalations, which we will now pass in review.

Aqueous vapour is stated to constitute the chief part of the exhalations from volcanic vents. We well know, also, that instances are recorded in which liquid water has been thrown out in torrents. There is one case in which even dead fish are reported to have been ejected, thus proving that in that case a sudden irruption of surface water into the subterranean cavities must have taken place.

Free hydrogen appears as a constituent in many analyses. A very large proportion was found by Bunsen in the gas from the smoking muddy soil of a large fumerole in the far north of Iceland. The proportion of hydrogen is very large, and it well deserves attention. I stated just now incidentally how hydrogen might be produced by the action of the vapour of water on basalt at a high temperature, the protoxide of iron being peroxidised at the expense of the water, with the liberation of hydrogen. The composition of the gas examined by Bunsen from this smoking muddy soil of the fumerole was—

Nitrogen	0.72
Carbonic acid	50.00
Sulphuretted hydrogen	24.12
Free hydrogen	25.14

Making a total of 99.98

Devil found hydrogen in the gas escaping from the liquid lava of Vesuvius, thrown out in the eruption in the winter of 1861-2.

Carburetted hydrogen, or marsh gas, was very carefully sought for by Bunsen, who failed to detect any evidence of its presence—at all events, in the gases of Iceland, and he came to this conclusion—(these are his own words)—“Volcanic gases are characterised by the absence of all combustible carbonaceous substances.” That, if it were correct, would be a very important conclusion. I have no doubt that it is correct as far as Bunsen’s observations extend. Deville, on the other hand, informs us that he found marsh gas in the gas evolved from the liquid lava of Vesuvius, thrown out in 1861, and also a very large proportion in gas of fumeroles in the vicinity of Etna. The gas collected in June from the little cones, which together constitute the Macaluba of Girgenti, was composed of—

Carbonic acid	1.15
Oxygen	1.70
Nitrogen	6.75
Marsh gas (the gas escaping from marshes).	90.40

100.00

He gives us many other analyses, but I give you that in which the hydrocarbon appears to the largest extent. Waltershausen informs us of the occurrence of rock oil or naphtha in clear drops in certain drusy cavities and holes in a doleritic basalt near Paterno, at the foot of Etna. The lava, moreover, which he saw erupted several days in November, 1838, from the crater of Etna, he assures us, smelt very strongly of naphtha.

Carbonic acid is a general constituent of volcanic gases. I have already mentioned its occurrence in two or three places.

Hydrochloric acid appears to be a very frequent constituent of volcanic exhalations. From Vesuvius, especially, it has been largely evolved, and also from Etna though in less proportion. In Iceland Bunsen was able to detect only traces of it in a free state in the crater fumeroles—that is to say, the fumeroles or volcanic vents in the crater—a few months old. It is reported—(this is a singular statement, if correct)—that no hydrochloric acid has been found in the gas from the volcanos of South America. The proportion of this gas in volcanic exhalations has been found to rapidly

decrease after the cessation of an eruption. There is no difficulty in accounting for the evolution of hydrochloric acid if we can only ensure this condition—exposure of an alkaline chloride intermixed with silica to the vapour of water at a high temperature. For instance, if we take common salt and mix it with silica, and then put the mixture in a porcelain tube and expose it to a red heat, and pass steam over it, we can evolve hydrochloric acid in torrents. The water is decomposed, the oxygen of the water oxidises the sodium of the chloride of sodium or common salt, producing soda, which combines with the silica, forming silicate of soda; and the hydrogen of the water combines with the chlorine of the chloride of sodium, forming hydrochloric acid, which passes off.

I will give one or two statements concerning the fumeroles of the eastern edge of the great crater of Vesuvius of 1850, as recorded by Deville. The maximum of intensity was towards September, 1855. Gases then escaped at a very high temperature and under pretty strong pressure. There were sulphurous acid and hydrochloric acid, and the relation of the hydrochloric acid to the sulphurous acid was as 86.2 to 13.8. In June, 1855, the simple condensation of the same acid vapours indicated that they consisted almost entirely of water, containing 99.9 per cent. The observations concerning temperature are interesting. The maximum temperatures of these fumeroles were as follows:—

In May, 1855, during the eruption, 85° Centigrade.

In June, 1855, 90°

In Sept., 1855, 180°

In June, 1856, 154°

The gas collected in June, 1856, always contained water in large proportion. Making a deduction for that water, the remaining gas consisted of—

Sulphurous acid	2.6
Oxygen	18.7
Nitrogen	78.7
	100.0

This composition shows clearly that atmospheric air must have had free access.

Sulphurous acid appears to be universally present in the gaseous evolutions from volcanoes. Bunsen found 1.54 per cent. in the gas from a vent in the great crater of Hecla; but in the gases from vents in the lava streams he could not detect it, and scarcely at all in the condensed vapour of those gases. We shall presently consider its possible source and mode of generation.

(To be continued.)

LECTURES ON CHEMICAL PHILOSOPHY.—II.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 57.)

We have first the law of specific heats. This law, established by Dulong and Petit, may be thus stated:—When we multiply the atomic weights of simple bodies by their specific heats we obtain a constant product. This is the same as saying that the quantities of each element representing their atomic weights have the same specific heat, or, rather, that all simple bodies have the same atomic heat.

There are, however, some exceptions to this law. Boron, silicon, and carbon have an atomic heat completely discordant with the law. We shall examine this anomaly further on.

Our atomic weights, identical with those of Berzelius (with the exceptions of the four metals lithium, sodium, potassium, and silver, which we halve), are, for the most part, double the equivalents. These atomic weights are also in harmony with the law of isomorphism. Thus, for example, Gerhard represented by Cu_2S the cuprous sulphide isomorphous with the sulphide of silver Ag_2S .

Cuprous sulphide should be written with the new numbers Cu_2S , a formula analogous to Ag_2S , as the law requires.

But isomorphism is only a secondary matter; the real foundation of the atomic notation is the law of Gay-Lussac, relative to the combinations of gases. It results from this law that the densities of gases and vapours are proportional to their atomic weights, and hence it follows that if we bring these densities into relation with that of hydrogen taken as unity, the same numbers will represent both the atomic weights and the densities.

The following diagram will make these relations clear:—

Simple bodies.	Densities in relation to air.	Densities in relation to hydrogen.	Atomic weights.
Hydrogen . . .	0.0693	1	1
Oxygen . . .	1.1056	15.9	16
Nitrogen . . .	0.9714	14.0	14
Sulphur (at 1000° C.)	2.22	32.0	32
Chlorine . . .	2.44	35.2	35.5
Iodine . . .	3.716	125.8	127

To calculate the density of a gas in relation to that of hydrogen taken as unity, it is only necessary to multiply the density in relation to air by $\frac{1}{0.0693} = 14.14$, the density of air in relation to that of hydrogen. We thus obtain numbers identical with those which stand on the diagram as the atomic weights.

There are some exceptions to this law also, and these we shall study presently.

And now having confirmed our system of atomic weights so far as regards simple gases, let us proceed to study it in relation to compound bodies, and see how we may deduce the atomic weights of these from their densities.

The relations which exist between the atomic, or rather the molecular weights of compound gases and their densities are of the most simple nature. We may express them by saying that *equal volumes of compound gases contain the same number of molecules*. It follows that the weights of the molecules are proportional to the densities. Here we have for the first time the notion of a *molecule*.

Let us consider hydrochloric acid—it contains equal volumes of chlorine and hydrogen. Two volumes of HCl contain 1 volume of Cl and 1 volume of H . If the volumes were atoms, we may say that 2 atoms of HCl contain 1 atom of Cl + 1 atom of H . Well, the union of these two atoms forms a molecule of HCl .

Two volumes of ammonia contain 3 volumes of H + 1 volume of N ; then 2 atoms of ammonia contain 3 atoms of H + 1 atom of N .

We know further that 2 volumes of ammonia combine with 2 volumes of HCl , which leads us to consider the quantities of HCl containing 1 atom of H + 1 atom of Cl , and corresponding to 2 volumes as equivalent to the quantity of ammonia containing 1 atom of N and 3 atoms of H , and also corresponding to 2 volumes. Both these quantities represent *molecules* of the compound gases. We may extend the same consideration to other compound gases, and see that if the weights of the atoms represent the weights of volumes, the molecular weights or the weights of the molecules will represent the weights of 2 volumes.

The *molecule* representing 2 volumes is the smallest quantity of a compound body which can exist in a free state, or can enter into or be withdrawn from a compound, while an *atom* is the smallest quantity of an element which can exist in a compound body.

We have shown that the molecular weights of compound gases are proportional to their densities. If the densities of these gases were brought into relation with hydrogen taken as unity, it would only be necessary to double the numbers to obtain the molecular weights. The density, in fact, represents the weight of one volume, and the molecular weight represents two volumes.

To find the molecular weights, then, we have only to multiply the densities in relation to air by

$$\frac{1}{2 \times 0.0693} = 28.88$$

or twice the relation of the density of air to the density of hydrogen.

Let us make the calculation for some compounds, and also for some elements, and so verify the law and its consequences.

	Density in relation to air.	Double density $\text{H}=1$.	Molecular weights.	Symbol.
Hydrogen . . .	0.0693	2	2	H_2
Chlorine . . .	2.44	70.5	71	Cl_2
Bromine . . .	5.54	159.0	160	Br_2
Iodine . . .	8.716	251.7	254	I_2
Cyanogen . . .	1.806	52.1	52	Cy_2
Methyl . . .	1.0365	29.9	30	Me_2
Hydride of methyl	0.558	16.1	16	MeH
Ethyl . . .	2.0462	59.09	58	Et_2
Oxygen . . .	1.1056	31.9	32	O_2
Sulphur (at 1000°).	2.22	63.5	64	S_2
Water . . .	0.6235	18.0	18	H_2O
Sulphuretted hydrogen . . .	1.1912	34.4	34	H_2S
Sulphurous acid . . .	2.234	64.5	64	SO_2
Nitrogen . . .	0.9714	28.0	28	N_2
Protoxide of nitrogen . . .	1.527	44.1	44	N_2O
Binoxide of nitrogen . . .	1.038	29.98	30	NO
Methylamine . . .	1.08	31.19	31	NMe_3
Ammonia . . .	0.591	17.07	17	NH_3
Phosphorus . . .	4.42	127.6	62	P_4
Phosphuretted hydrogen . . .	1.184	34.2	34	PH_3
Protochloride of phosphorus . . .	4.472	136.9	137.5	PCl_3
Arsenic . . .	10.6	306	150	As_4
Arseniuretted hydrogen . . .	2.695	77.8	78	AsH_3
Chloride of arsenic . . .	6.3006	181.9	181.5	AsCl_3
Chloride of silicium . . .	5.939	171.5	170	SiCl_2
Mercury . . .	6.976	201.4	100	Hg
Mercuric chloride . . .	9.8	283	271	HgCl_2
Cadmium . . .	3.84	12	56	Cd
Carbonic oxide . . .	0.967	27.9	28	Co
Carbonic acid . . .	1.529	44.1	44	Co_2
Marsh gas . . .	0.559	16.1	16	CH_4
Ethylene . . .	0.9784	28.2	28	$(\text{C}_2\text{H}_4)''$
Chloride of ethylene . . .	3.4434	99.4	99	$(\text{C}_2\text{H}_4)''\text{Cl}_2$

This diagram shows us the exceptions to the law of Ampère we have already alluded to. In the next lecture we shall continue the study of this law and discuss the exceptions.

ACADEMY OF SCIENCES.

July 25.

MM. H. DEVILLE AND TROOST, in continuation of their experiments on the means of determining high temperatures, describe a porcelain apparatus by which they measured a temperature reaching as high as 1530°C . The description is too long to be given here, but the account leaves no doubt that we have now a "pyrometer capable of giving indications of great exactness, and of receiving important applications." We may add that at the temperature given above copper and silver seemed to be vaporised, and feldspar was fused to a perfectly clear glass. An iron nail, however, showed no signs of fusion.

Father Secchi has continued his observations on the atmospheric lines of the planets. Taking advantage of the moon being in the neighbourhood of Jupiter and Saturn, he compared the spectra of the three, and satisfactorily made out the presence of the atmospheric lines in the

spectra of the planets, and the absence of them in that of the moon.

M. Margueritte, in another note "*On the Carburization of Iron by Carbonic Oxide*," details some experiments which leave no doubt on his mind that iron is cemented by carbonic oxide, and that the presence of nitrogen is not indispensable. After procuring pure iron by reducing the oxalate in a current of hydrogen, he calcined it in presence of pure carbonic oxide, and found that carbonic acid was evolved, and the weight of the iron (which was completely converted into steel) increased.

M. Hautefeuille gives an account of a "*Method of Producing Artificially Crystals of Anastase, Brookite, and Rutile*." These were formed by heating fluoride of titanium to different temperatures in the presence of aqueous vapour.

In a paper "*On the Production of Ammonio-Magnesian Phosphate*," M. Lesieur shows that this salt is produced when ammonia is added to a phosphate of magnesia, or magnesia is added to acid phosphate of ammonia. The announcement of these facts no doubt startled the chemists present at the meeting.

M. Millon also announced a great discovery. In a note "*On a New Means of Destroying Organic Matter Present with Mineral Matters*," he states that if the mixed substances are first heated in a retort with sulphuric acid, and then ignited in a platinum crucible, nitric acid being dropped in occasionally, the organic matters will be completely burned away, and a perfectly white residue left. The author is at the pains to add that, under these circumstances, carbonates, chlorides, iodides and bromides, and organic salts are destroyed, and sulphates left in their place.

M. Maumené presented a second memoir on "*A General Theory of the Exercise of Affinity*." The author does not believe in types nor in substitutions. As we shall shortly have M. Wurtz's lecture on the subject, we will leave M. Maumené's reasons for the present.

We recently announced that M. Bechamp had discovered a new hydrocarbon in coal-tar. M. Naquet now comes forward and claims the discovery as well, and, being further advanced with its examination, gives the formula as C_9H_{12} . The author has commenced a series of comparative experiments with the new body, and with cumene procured from cumic acid, and also with mesitylene from acetone.

MM. De Vry and Alluard publish a paper "*On the Rotatory Power of Quinine*." They compared the best quinine of commerce with pure quinine made by themselves, and found, as might be expected, that the polarising apparatus revealed the presence of impurities when in too small quantities to be detected by chemical processes. The experiments were undertaken in consequence of the authors having found the determinations of Bouchardat incorrect. The reader interested in this subject will find full particulars of the experiments in this paper.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1229. Louis Bricout, Rheims, France, "Improvements in apparatus employed in carburetting gas."—Petition recorded May 14, 1864.

1624. Charles Frielinghans, King Street, Cheapside, London, "Improvements in the manufacture of starch and yeast, and the machinery employed therein."—A communication from Ignatz Ben, of Nedingen, Prussia.—Petition recorded June 29, 1864.

1631. John Corby, Dunoon, Argyshire, N.B., "Improvements in centrifugal machines, such as are used for separating syrup from sugar, and in apparatus for making the same."—Petition recorded June 30, 1864.

1656. Samuel Fox, Deepcar, near Sheffield, "Improvements in treating slags or cinders in order to obtain or produce cast steel therefrom."—Petition recorded July 2, 1864.

1663. George Holworthy Palmer, Queen's Crescent, Haverstock Hill, Middlesex, "Improvements in apparatus for heating and evaporating liquids and fluids."

1668. William Lloyd, Dartmouth Street, Westminster, "Improvements in the manufacture of hydro-carbon gas, and in apparatus employed therein."—A communication from William Henderson, Valparaiso, South America.—Petitions recorded July 5, 1864.

1686. John Henry Johnson, Lincoln's Inn Fields, "Improvements in the smelting or reducing of lead ores, and in the refining and softening of lead."—A communication from Prof. Alexander Hill Everett, New York, U.S.A.

1691. James Wilson, Exeter, Devonshire, "Improvements in tanning, and in the machinery or apparatus employed therein."—Petitions recorded July 7, 1864.

1694. Louis Henry Gustavus Ehrhardt, Richmond Road, Bayswater, Middlesex, "An improved gunpowder."

1695. Alfred Blake, Castle Brewery, Newport, Monmouthshire, "Improving water for the purposes of brewing, and beer produced therefrom."

1701. Abraham Rogers, New Wortley, near Leeds, Yorkshire, "Improvements in the means or apparatus for supplying fuel or heat to steam boilers or other furnaces, applicable also for ventilating mines and similar purposes."—Petitions recorded July 8, 1864.

1705. Jean Joseph Montié, Paris, France, "Improvements in distilling apparatus suitable for rectifying, separating, or combining, with other suitable matters, benzol, petroleum, or other more or less volatile hydrocarbons or their derivatives, concentrating acids, treating alcoholic products, or other similar purposes."

1709. George William Wyckham Webbe and Frederick Cant, Croxted Road, Dulwich, Surrey, "Improvements in the manufacture of paints."—Petitions recorded July 9, 1864.

1714. Jonathan Wright Horsfall, Longwood Avenue, Dublin, "Improvements in the manufacture of peat, coal, or fuel."

1727. Stephen Carey, East Ham, Essex, "Improvements in apparatus for calcining bones, and for reburning and revivifying animal charcoal."

1729. Ludwig Schad, Cassel, in the Electorate of Hesse, "Improvements in the manufacture of pigments."

1732. John Forbes, Perth, N.B., "Improvements in distilling liquids, and in the machinery, apparatus, or means employed therefor."—Petitions recorded July 12, 1864.

1759. Alexander Angus Croll, Coleman Street, London, "Improvements in the manufacture or preparation of material for the purification of gas."—Petition recorded July 14, 1864.

1813. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of and mode of applying explosive compounds."—A communication from Alfred Nobel, Hélieneborg, Stockholm, Sweden.—Petition recorded July 20, 1864.

Notices to Proceed.

1232. Joshua Womersley, Norwich, "Improvements in the manufacture of paper from certain fibrous substances."—Petition recorded May 16, 1864.

1301. John Baird and John McIntyre, Alexandria, Dumbartonshire, N.B., "Certain improvements in apparatus employed for clearing and bleaching textile fabrics."—Petition recorded May 25, 1864.

1545. James Forbes, Old Ford, Bow, Middlesex, "Improvements in the means of, and apparatus for manufacturing sulphate of ammonia and sulphuric acid."—Petition recorded June 21, 1864.

1564. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "Improvements in apparatus for

smelting and reducing ores and metals."—A communication from Loomis George Marshall, Philadelphia, Pennsylvania, U.S.A.

629. Louis Adolphe Durrieu, Soho Square, Middlesex, "Improvements in the method of clearing or causing to disappear from wool, woollen yarn, woollen fabrics, mixed woven fabrics, or felted cloths or fabrics, the specks caused by particles of matter in wool or fabrics, above-mentioned, and other blemishes which do not receive the dye equally with the general body of the fabric or substance."—A communication from François Romain Joly, Gaillon (Eure), France.—Petition recorded March 12, 1864.

690. Louis Adolphe Durrieu, Soho Square, Middlesex, "Improvements in the dyeing of woollen and other fabrics."—A communication from Louis Gouchon, Lisieux, France.

721. John Leslie, Conduit Street, Hanover Square, Middlesex, "Improvements in apparatus for generating heat."—Petition recorded March 22, 1864.

754. Richard Archibald Brooman, Fleet Street, London, "An improved method of, and improved apparatus for, revivifying animal black."—A communication from Jean Baptiste Felix Trolliet, Lyons, France.—Petition recorded March 26, 1864.

993. D'Herman Lomer, Brussels, Belgium, "Obtaining colouring matter as substitute for aniline colours."—Petition recorded April 21, 1864.

1631. John Corby, Dunvon, Argyleshire, N.B., "Improvements in centrifugal machines, such as are used, for separating syrup from sugar, and in apparatus for making the same."—Petition recorded June 30, 1864.

CORRESPONDENCE.

Deposit of the Nile.

To the Editor of the CHEMICAL NEWS.

SIR,—Some relatives of mine have lately returned from the Nile, and brought some of the *mud* that is deposited by the water of that famous river. It may interest some of your readers to know that it is constituted as follows, after being subjected to a qualitative analysis:—Principal constituents: silicic acid, alumina, proto and sesquioxide of iron, with traces of phosphate of alumina, and organic matter containing ammonia. I am, &c.

SHERIDAN MUSPRATT, Ph.D.

College of Chemistry, Liverpool, July 27.

Science in Courts of Law.

To the Editor of the CHEMICAL NEWS.

SIR,—Patent cases often involve scientific questions, and, perhaps, more than any other kind of cases, demand some knowledge of science from the tribunal which should try them. On these grounds it is now pretty generally admitted that they are not suited to the capacity of juries, and trial before a judge without a jury has come to be the order of the day.

At first sight one would very naturally be inclined to regard this as an improvement; but any such notion will be dispelled by a little reflection, and still more completely by a review of the actual cases which have been tried under the new arrangement.

In truth, we could hardly expect the judge to be less ignorant of science than the jurymen. The judge will be found rather more facile in his expression of ignorance than the jurymen; but one is about as devoid as the other of the necessary scientific culture.

The justice of these remarks is very strikingly brought out by the recent "Magenta" trial, *Simpson v. Holliday*. In his judgment on this case the judge had occasion to speak of the mixture of an aqueous solution of arsenic acid with aniline—i.e., of the aqueous solution of arseniate of aniline. He delivered himself in the following manner:

—"You cannot get colour* above 212° until all the water has gone out, because as long as free water is there—not in combination, making a hydrate—as long as it is not water of combination, but merely the water of solution, until you have got off that water of solution the vapour keeps down the heat you apply to the boiling point, which is 212° . Therefore, you have to get rid of all that before the process takes place. Dr. Hofmann explained that by an experiment which he made. He mixed it with water, he weighed the quantity of water which came off in the shape of vapour at 212° ; he took care to preserve it when distilled, and the water that came off was the same as the water of solution; and the moment he had done that the colour appeared."

Evidently, therefore, the judge considered that a strong aqueous solution of a salt must boil at 212° , which is a most decided blunder.

It is curious to observe how this error affects the whole case. Thus, when the preparation of arsenic acid came on for discussion, an evident corollary of this false science was, that in boiling down an aqueous solution of arsenic acid the evaporation must take place at 212° . Therefore, if you boiled down to physical dryness you must get the hydrate richest in water that is physically dry at 212° .

The fact is, that a strong aqueous solution of arsenic acid boils at something like 400° Fahr., and it is the acid physically dry at 400° , and not at 212° , that is the result of this boiling down to physical dryness.

It is unfortunate for the country that an important case like this Magenta case should be made to depend upon the dictum:—"Aqueous solutions must have the boiling point of pure water."

Charles Dickens was not very far off the mark when he described the "Circumlocution Office," with its art of "How not to do it." The Circumlocution Office has lately shown itself to be almost equally proficient in the art of not arriving at the truth. I am, &c. W.

MISCELLANEOUS.

The Powers of Gun-Cotton.—The *Quarterly Journal of Science* contains a paper, by Mr. Scott Russell, on "Gun-cotton;" in which he explains some of its properties, as follows:—"Ask gun-cotton to separate a rock already half-separated, it will refuse to comply with your request. Give it a light burden of earth and open rock to lift, it will fail. If you want it to do the work, you must invent a *ruse*,—you must make believe that the work is hard, and it will be done. Invent a difficulty and put it between the cotton and its too easy work, and it will do it. The device is amazingly successful. If the cotton have work to do that is light and easy, you provide it with a strong box, which is hard to burst—a box of iron, for example; choose a small charge, that would be harmless, in a little iron box, and then place that box in the hole where formerly the charge exploded harmless, and in the effort it makes to burst that box, the whole of the light work will disappear before it."

ANSWERS TO CORRESPONDENTS.

* * All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

At the time of going to press our Paris letter had not arrived.

W. B.—Deferred for the present.

X. will see the point discussed in a future lecture.

W. G. S. W.—The elements of the Maynooth battery are cast-iron and zinc. The outer cell is of cast-iron, containing strong nitric acid, and the amalgamated zinc is placed in a porous cell with diluted sulphuric acid. The arrangement is the same as in Grove's.

* Colour appears from the context to be a clerical error for "the mixture," i.e., the solution of arseniate of aniline in water.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Difference between Active and Ordinary Oxygen,
by M. CLAUSIUS.

SOME years ago M. Clausius put forth an hypothesis on the nature of ordinary and active oxygen or ozone bearing resemblance to previous hypotheses proposed by other chemists (notably MM. Favre and Silbermann, Gerhardt, and Brodie), and which he expresses in the two following propositions:—

1. Ordinary oxygen is formed of atoms united in binary groups, active oxygen of isolated atoms.

2. The two atoms constituting a molecule of ordinary oxygen are in opposite electric conditions.

To these two fundamental hypotheses are added the two following accessory hypotheses:—

3. The two isolated atoms proceeding from the division of a molecule of ordinary oxygen immediately lose their positive or negative electricity and become neutral.

4. The atoms remaining isolated if a volume of ozone contains the same number of molecules as the same volume of some other simple gas, the density of the ozone should be half that of ordinary oxygen.

The third hypothesis is hardly compatible with the existence of antozone, nor with the well-known property of ozone of exercising two opposite actions on oxygen held in combination. M. Clausius, moreover, thinks it better to abandon it. He consequently admits that ozone is formed of electro-negative atoms, and antozone of electro-positive atoms, besides which he thinks it probable that the atoms of ozone constantly retain their electro-negative state, but that the facts as yet known do not authorise so precise a conclusion with regard to antozone.

As to the fourth hypothesis, it has become absolutely inadmissible, since the recent experiments of M. Babo and M. Soret have established the fact that ozonised oxygen increases in volume in passing to the state of ordinary oxygen. To reconcile this remarkable phenomenon with his fundamental hypothesis, M. Clausius now supposes that the isolated atoms of active oxygen are able to unite by reason of a feeble affinity between binary molecules of ordinary oxygen; the density of the gas is thus augmented without sensibly diminishing the chemical activity proper to the isolated negative or positive atoms.—*Annales de Chimie et de Physique*, i., 499, 1864.

Researches on Oxygen, by Dr. G. MEISSNER.

(Continued from page 49.)

THE very different behaviour of the two bodies formed from ordinary oxygen by electrification affords an easy means of separating them. If we fill a large dry flask with strongly electrified air or oxygen, and then put in a little water and shake, a cloud is formed. When the water is poured out, and the well-closed flask is left to itself, the cloud gradually disappears; and when the air has become quite transparent it is easy to prove the presence of ozone.

Atmizone, like ozone, can also be suddenly destroyed. If the electrified air or oxygen be passed through a strongly-heated tube no cloud will be formed when the gas comes in contact with water. Andrews has shown that a temperature of 235° or 240° is sufficient to destroy ozone, and an equal temperature will effect the destruction of atmizone, whether moist or dry.

Atmizone, moist or dry, is also destroyed by contact with platinum-black or the binoxides of manganese and lead.

A slight increase of temperature seems to effect no change in atmizone; but in contact with nearly boiling water it is destroyed in two moments. We have seen that in contact with water atmizone changes more quickly than in the dry condition, and we now see that in contact with hot water the change is effected at a lower temperature than by the application of a dry heat.

We have hitherto studied the behaviour of atmizone after the removal of ozone; we shall now investigate its behaviour in the presence of ozone. When electrified air or oxygen is led directly into water a cloud appears if the air was dry until it entered the water, and it was, moreover, strongly electrified. But when ozone is present the mist is always much weaker than when the air stream is first deozone and then saturated with moisture.

The following is the best way of showing the difference:—The tube in which the stream of air or oxygen is electrified is connected with a forked tube, one arm of which passes into iodide of potassium solution and then into water, while the other passes directly into water. Under these circumstances it will be seen that a mist is formed in each case, but is much stronger on the deozone side. The question, Why the presence of ozone diminishes the mist forming power of the atmizone? admits of two possible answers. It may be that the deozone air contains much less atmizone; or it may be that the amount of atmizone is not diminished, but that the ozone interferes with the attraction of atmizone for water. The author then proceeds to detail several experiments, which show, first, that when atmizone and ozone are together in the presence of aqueous vapour, the attraction of the atmizone for water is greatly diminished; and, secondly, that in the presence of ozone atmizone is much more quickly changed than when that body is absent.

We unfortunately possess no means of estimating atmizone quantitatively, but the author gives reasons for supposing that ozone and atmizone exist in the electrified air or oxygen in equivalent quantities. He also supposes that under most circumstances they disappear, or revert to common oxygen in equivalent quantities; but when a stream of electrified air containing a mixture of the two is examined in the manner just described, the atmizone changing more quickly than ozone, the latter soon predominates so much as to prevent the atmizone from forming a cloud.

In the dry state, as before remarked, ozone and atmizone change more slowly than when moist. This is also true of a mixture of the two; but it was noticed that in the dry state the change in the atmizone involved the change of more ozone than took place when the mixture was moist.

The next chapter of this interesting work details the experiments of the author to ascertain whether the body to which we have hitherto given the name of *atmizone* is identical with Schönbein's *antozone*. According to Schönbein the peculiar characteristic of antozone as distinguished from ozone is its power of converting water into peroxide of hydrogen HO_2 , which ozone will no more effect than common oxygen. Meissner therefore first endeavoured to ascertain whether atmizone would oxidise water, and produce oxygenated water. As a preliminary step, and in order to make certain of having a delicate and safe test for the peroxide of hydrogen, the author repeated all Schönbein's experiments on the preparation and recognition of the peroxide.

As is well known, Schönbein first prepared free antiozone from peroxide of barium. He noticed that when finely-powdered peroxide of barium was dropped into monohydrated sulphuric acid, the oxygen evolved had a peculiar smell like that of ozone, and possessed strongly oxidising properties, but still presented this essential difference to ozone, that at a low temperature it had a strong disposition to oxidise water to HO_2 . This experiment Meissner confirmed. He took a wide glass tube something like a test-tube, and furnished with a ground-glass stopper, and supported within it a shorter and narrower tube. In the larger tube he placed water, and in the smaller pure sulphuric acid, and arranged that the surface of the water should not be far from the sulphuric acid. He now dropped small quantities of finely-powdered peroxide of barium into the sulphuric acid at short intervals, replacing the stopper after each addition. The author noticed that the oxygen evolved had a peculiar smell somewhat resembling that of ozone, but by an immediate comparison he found a remarkable difference; he noticed also on breathing the gas that it produced a choking sensation, an effect which ozone does not produce. The water he found absorbed this gas with avidity, and after some time he had a dilute solution of peroxide of hydrogen. During the experiment the temperature of the tube must be kept low, and it is convenient to change the sulphuric acid tube occasionally. Pure ozone, whether produced by electricity or by the slow combustion of phosphorus, Schönbein has proved never oxidises water. In this way, however, only a very dilute oxygenated water is produced, and the author next set about producing a much stronger solution.

(To be continued.)

British Pharmaceutical Conference.—The meetings for the present year will be held at 41, Milsom-street, Bath, and will commence on Wednesday, September 14. Papers to be read must be sent to the Secretaries fourteen days before the commencement of the meetings. The local secretary is Mr. J. C. Pooley, who will afford members all the information desired.

Chloroform a Test for Sugar in Urine.—M. Cailliau states that when urine containing sugar is violently shaken with half its bulk of chloroform, the mixture becomes milky, and will separate into two layers. The upper is clear and almost colourless, while the lower is white, thick, and gelatinous. When the upper layer is removed, and left to evaporate in a porcelain dish, the liquid becomes syrupy as it evaporates, and after some days the sides of the dish become covered with the wart-like masses of sugar.—*Journal de Chemie Med.*, xi., 449.

Aniline in Varnishes.—When an alcoholic solution of aniline is evaporated upon a glass plate, there remains a thin transparent coating of aniline, which by reflected light appears as a metallic green iridescence, but by transmitted light of a blue or violet colour, according to the shade of aniline used. As aniline is soluble also in spirit varnishes, it is proposed to prepare such a blue transparent varnish for coating bottles, used for the preservation of substances easily affected by light.—*N. Jahrb. Ph.* xx. 44.

Soda in Coal Gas.—On examining the flame of the gas supplied in Munich, Professor Vogel remarked a pale soda line which was not observed when the gas was passed through sulphuric acid. On analysing afterwards the deposit on the surface of a copper burner which had been in use a year, the Professor found a considerable proportion of sulphate of soda.—*Neues Repert. für Pharm.*, xii., 8-75.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, F.C.S.

(Continued from vol. ix., page 244.)

7. **Discovery of Boyle's Law.**—About a year after the publication of Boyle's "Physico-Mechanical Experiments," Francis Linus published a treatise* in which he sought to prove the impossibility of the production of a vacuum, and the consequent fallacy of the results obtained by Boyle. The objections brought forward by Linus are, if possible, more absurd than those of Hobbes; they were very ably answered by Boyle,† and utterly unreasonable as was the theory on which they were based, we can but feel glad that it was propounded, inasmuch as in making experiments for its refutation, Boyle discovered the celebrated law of the compression of gases.

Linus admitted that the air possesses both weight and elasticity, but he denied that it is competent, in virtue of those properties, to produce the effects attributed to it by the vacuists.

One of the chief arguments adduced by Linus, against the explanation given by the vacuists of the Torricellian experiment, is the following:—If we take a tube less than $29\frac{1}{2}$ inches long, say 20 inches, fill it with mercury, and then invert it in a vessel of mercury, the upper orifice of the tube being closed by the finger, the latter is found to be strongly pressed down; now, he reasons, if the air can support $29\frac{1}{2}$ inches of mercury, and there are but 20 inches in the tube, the finger ought to be pressed upwards instead of downwards. To this Boyle answers very truly, that the finger has greater pressure on its upper surface than on its lower, because it has to bear the whole weight of the atmosphere on its upper surface, whereas below it has to bear the weight of the atmosphere—the weight of the column of mercury in the tube; hence, if there are 20 inches of mercury in the tube, the lower surface of the finger will be pressed upon by only one-third of the weight which presses upon its upper surface.

Again, argues Linus, if a tube 20 inches long is nearly filled with mercury, the upper orifice closed by the finger, and the lower opened beneath the surface of mercury, the mercury in the tube will descend somewhat, and the finger will be pressed strongly against the tube, if the air, then, cannot support 20 inches of mercury, how can it support $29\frac{1}{2}$ inches? And if it be argued that the spring of the included air pushes down the mercury, it follows that the finger ought to be pushed upwards; but, answers Boyle, the upper part of the finger has to bear the whole weight of the atmosphere, whereas the air in the tube beneath the finger has the weight of the column of mercury to help it to overcome the weight of the atmosphere.

In order to account for the suspension of the mercury in the Torricellian experiment, Linus proposed his "Funicular hypothesis," which affirmed that the mercury remains suspended in the tube by a "funiculus" or cord of very thin matter, which is forcibly distended by the weight of the mercury, and perpetually endeavours to contract; when the mercury column has distended it to the extent to which such a weight is competent, the column rests suspended in the tube by the funiculus. Not only the Torricellian experiment, but all the effects affirmed by the vacuists to be due to the weight and

* "De Corporum Inseparabilitate, 1661."

† See "A Defence of the Doctrine touching the Weight and Spring of the Air, proposed by Mr. Boyle in his new Physico-mechanical experiments, against the objections of Franciscus Linus." By the Author of those experiments. London: 1662.

elasticity of the air were attributed by Linus to the action of his funiculus.

Boyle speaks of the theory as being "partly precarious, partly unintelligible, and partly insufficient, and besides needless;" it is curious, moreover, he remarks, that the funiculus should not only support a column of such a heavy liquid as mercury, but should also be able to draw in the sides of a glass vessel with sufficient force to break it; it is also remarkable that a pendulum should vibrate so readily in an exhausted receiver, if it has to cut through a number of stretched cords.

Pascal's Puy de Dôme ‡ experiment proved decisively the fallacy of all the theories of the Plenists; Linus was well aware of this, and he chose to doubt the accuracy of the experiment, because having tried it on the summit of a hill of but small elevation, it did not appear to succeed. Boyle replies that inasmuch as the Puy de Dôme experiment had been repeated five separate times, and had also been made in England with similar results, there can be no doubt of its accuracy. Mr. Richard Townley, a friend of Boyle's, modified the experiment by allowing a small quantity of air to remain in the tube above the mercury, and he found this enclosed air occupied a larger volume on the summit of a mountain than at its base.

In order to prove that the experiment obtains with small elevations, Boyle constructed a modified air thermometer, which would indicate very slight changes in the pressure of the air. This instrument consisted of a capacious glass bottle, into the neck of which a glass tube, open at both ends, was cemented; the tube reached nearly to the bottom of the vessel, and dipped beneath the surface of a small quantity of water placed therein, thus the air within the vessel had no communication with that outside; increase of pressure of the air would obviously cause the water to sink within the tube; whereas diminution of pressure would cause the air within the instrument to expand, and consequently to raise the water in the tube above the level of that in the vessel; it is needless to remark that such an instrument would only show difference of pressure in the air when the temperature was constant. The exact height at which the water stood on the ground was observed. Boyle then drew up the instrument by a rope to the leads of Westminster Abbey, a height of seventy-five feet from the ground: the water was found to have risen one inch in the tube, the temperature remaining constant.

We come now to the discovery of the important law which affirms that *the volume of a gas varies inversely as the pressure to which the gas is submitted*, and inasmuch as there is some dispute as to whether Boyle or the French philosopher Mariotte was the first to discover the law, we will consider the subject somewhat in detail.

In France and Germany the law is almost universally called "the law of Mariotte," in England generally "the law of Boyle and Mariotte;" sometimes "the law of Mariotte," seldom "the law of Boyle." I shall endeavour to prove that it is rightly the law of Boyle.

Roberval§ enclosed a partially inflated carp's bladder in the Torricellian vacuum, and observed that it became fully inflated. Boyle made the same experiment with a lamb's bladder in the vacuum produced by his air-pump; on exhaustion, the bladder became fully inflated, and on the re-admission of air contracted to its former dimen-

sions; he next inclosed air in a tube and measured its expansion on the removal of pressure; it was found to expand more and more with every stroke of the pump, until eventually it occupied 152 times its original bulk, to which latter it returned on the re-admission of air. Here, then, was the important fact that the greater the amount of pressure removed from air the more does it expand.

In order to see if the pressure of the air is the sole cause of the suspension of the mercury in the Torricellian experiment, Boyle (in the 17th of the Physico-mechanical experiments||) filled a tube three feet long with mercury and inverted it in a vessel of mercury, which latter he placed in the air-pump receiver, the tube being passed air-tight through its cover; on exhausting, the mercury fell lower and lower with every stroke of the pump, till it was almost on a level with the mercury in the vessel in which the lower end of the tube was placed; on admitting air into the receiver, the mercury rose above twenty-nine inches, on letting out the air it sank again to that height. It was thus indisputably proved that the height of the mercury is greater or less according as the density of the air pressing upon it is greater or less.

As the capacity of the receiver and of the air-pump cylinder could be readily determined, and thus the fall of the mercury in the tube due to the removal of a known amount of air, Boyle hoped to be "enabled to give a near guess at the proportion of force betwixt the pressure of the air (according to its various states, as to density and rarefaction) and the gravity of quicksilver," but on account of several difficulties which he mentions, and of the little leisure at his disposal, he says he shall content himself with having suggested the experiment.

We see, therefore, that prior to 1660 Boyle suggested a method for determining the relation of the density of air to the weight which it supports. After making the experiments given above, the discovery of Boyle's law was inevitable; no thinking man could make those experiments without inquiring whether the removal of a definite amount of pressure caused a definite expansion of the released air.

Let us now pass on to the actual discovery of the law.

The fifth chapter of the second part of Boyle's "Defence against Linus" is entitled "Two new experiments touching the measure of the force of the spring of air compressed and dilated."

Linus, as before mentioned, had throughout his treatise affirmed that the elasticity of the air is incompetent to produce the effects attributed to it by the vacuists; the experiments detailed in this chapter were made by Boyle in order to prove that the spring of the air is able to effect not only as much but far more than the vacuists attribute to it.

To prove this Boyle procured a long glass tube, and bent it in the form of a syphon with parallel limbs, each of which was divided into inches and eighths; one limb was considerably shorter than the other, and its orifice was hermetically sealed,¶ (in fact, the instrument was exactly similar to that which we use in the present day

|| This and the previous experiment have been before mentioned in the fourth and fifth of these papers. They are introduced here because they bear upon the discovery of Boyle's law.

¶ Boyle had previously (in the 36th of the Physico-mechanical experiments) made use of a similarly shaped tube open at both ends for determining the relative weights of water and mercury. Mercury was poured into the tube till it stood level in each limb at the commencement of the scale; water was then poured in the longer limb, and it was found that $30\frac{1}{2}$ inches of water balanced $2\frac{1}{2}$ inches of mercury, making the relative weights of mercury and water as 1 to $13\frac{2}{11}$.

‡ For an account of this experiment see the third of these papers. CHEMICAL NEWS, vol. viii, p. 247.

§ This experiment is first mentioned in a work which was published by the Accademia del Cimento, and which contains an account of the experiments made by its members. Of this important scientific society we shall have to speak hereafter.

for illustrating Boyle's law). Mercury was poured into the instrument until it stood level in each limb at the commencement of the scale, mercury was then poured into the longer limb until the air in the shorter was reduced to half its original bulk, "when," he writes, "we cast our eyes upon the longer leg of the glass, on which we likewise pasted a list of paper carefully divided into inches and parts, and we observed, not without delight and satisfaction, that the quicksilver in that longer part of the tube was twenty-nine inches higher than the other." . . . "We were hindered," he continues, "from prosecuting the tryal at that time by the casual breaking of the tube. But because an accurate experiment of this nature would be of great importance to the doctrine of the spring of the air, and has not yet been made (that I know) by any man, . . . we at last procured a tube of the figure exprest in the scheme." This tube was exactly similar in form to the other, but larger in its dimensions; from experiments made with it, Boyle deduced the following table, which he calls

"A Table of the Condensation of the Air."

A	B	C	D
Space occupied by the air in the shorter limb of the instrument in inches.	Height of the column of mercury in the longer limb, the weight of which column caused the change of volume shown in A.	Pressure sustained by the air in the shorter limb, expressed by the height of the column of mercury in the longer limb + 29 $\frac{1}{16}$ inches, the height of the column of mercury supported by the atmosphere.	Theoretical pressure sustained by the air in the shorter limb, if we suppose "the pressures and expansions to be in reciprocal proportions."
12	00	29 $\frac{2}{16}$	29 $\frac{2}{16}$
11 $\frac{1}{2}$	01 $\frac{7}{16}$	30 $\frac{9}{16}$	30 $\frac{6}{16}$
11	02 $\frac{13}{16}$	31 $\frac{15}{16}$	31 $\frac{12}{16}$
10 $\frac{1}{2}$	04 $\frac{6}{16}$	33 $\frac{8}{16}$	33 $\frac{7}{16}$
10	06 $\frac{3}{16}$	35 $\frac{5}{16}$	35
9 $\frac{1}{2}$	07 $\frac{14}{16}$	37	36 $\frac{15}{19}$
9	10 $\frac{2}{16}$	39 $\frac{4}{16}$	38 $\frac{7}{8}$
8 $\frac{1}{2}$	12 $\frac{8}{16}$	41 $\frac{10}{16}$	41 $\frac{2}{17}$
8	15 $\frac{1}{16}$	44 $\frac{3}{16}$	43 $\frac{11}{16}$
7 $\frac{1}{2}$	17 $\frac{15}{16}$	47 $\frac{1}{16}$	46 $\frac{3}{5}$
7	21 $\frac{3}{16}$	50 $\frac{5}{16}$	50
6 $\frac{1}{2}$	25 $\frac{3}{16}$	54 $\frac{5}{16}$	53 $\frac{10}{13}$
6	29 $\frac{11}{16}$	58 $\frac{13}{16}$	58 $\frac{2}{8}$
5 $\frac{3}{4}$	32 $\frac{3}{16}$	61 $\frac{5}{16}$	60 $\frac{18}{23}$
5 $\frac{1}{2}$	34 $\frac{15}{16}$	64 $\frac{1}{16}$	63 $\frac{6}{11}$
5 $\frac{1}{4}$	37 $\frac{15}{16}$	67 $\frac{1}{16}$	66 $\frac{1}{7}$
5	41 $\frac{9}{16}$	70 $\frac{11}{16}$	70
4 $\frac{3}{4}$	45	74 $\frac{2}{16}$	73 $\frac{11}{19}$
4 $\frac{1}{2}$	48 $\frac{12}{16}$	77 $\frac{14}{16}$	77 $\frac{2}{3}$
4 $\frac{1}{4}$	53 $\frac{11}{16}$	82 $\frac{12}{16}$	82 $\frac{4}{17}$
4	58 $\frac{2}{16}$	87 $\frac{14}{16}$	87 $\frac{3}{8}$
3 $\frac{3}{4}$	63 $\frac{15}{16}$	93 $\frac{1}{16}$	93 $\frac{1}{8}$
3 $\frac{1}{2}$	71 $\frac{5}{16}$	100 $\frac{7}{16}$	99 $\frac{6}{7}$
3 $\frac{1}{4}$	78 $\frac{11}{16}$	107 $\frac{13}{16}$	107 $\frac{7}{13}$
3	88 $\frac{7}{16}$	117 $\frac{9}{16}$	116 $\frac{4}{8}$

Boyle next made some experiments on the expansion of air under diminished pressure. He was informed, however, by the afore-mentioned Mr. Townley, that he (Mr. Townley), since reading the "Physico-Mechanical Experiments," had endeavoured—acting, I suppose, on the suggestion given by Boyle in the seventeenth experiment mentioned above—to determine the amount of expansion of a certain quantity of air on the removal of known amounts of pressure. Townley had commenced a paper on the subject, which he showed to

Boyle, but it was apparently never published.** Boyle does not mention whether he employed the same method as that adopted by Townley.

Boyle's method was the following:—A long tube, one end of which was open and the other hermetically sealed, was divided into inches and eighths; it was filled with mercury and placed in a vessel of mercury of the same depth as itself. One inch of air was then passed into the upper part of the tube, the mercury within and without being brought to the same level. The tube was now raised till the air within it had expanded to double its volume, and the pressure acting upon it determined by subtracting the height of the column of mercury below the air from 29 $\frac{3}{4}$ inches, which at the time of making the experiment was the height of the column of mercury supported by the atmosphere. The arrangement of the apparatus was exactly the same as that figured in our present works on physics. Boyle gives a table of the results which he obtained, which he calls "A Table of the Rarefaction of the Air."

Let us now consider the claims of Mariotte.

Fourteen years†† after Boyle published the above experiments, Mariotte's "Essai sur la Nature de l'Air," first made its appearance. In this essay‡‡ Mariotte informs the reader that the first great property of air is that it possesses weight, the second that it is capable of condensation and expansion; he then passes at once to the question whether the air is condensed in exact proportion to the weight which acts upon it. In order to ascertain this, Mariotte, together with a M. Hubin, procured a glass tube 40 inches long, sealed one end of it hermetically, and poured in mercury until it stood at 27 $\frac{1}{2}$ inches from the end of the tube, the open end was then closed by the finger, the tube inverted, and opened beneath the surface of mercury; the mercury in the tube fell till it rested 14 inches above that in the vessel, and the air occupied 25 inches; 24 inches of mercury were next placed in the tube, on inverting the mercury fell to 7 inches, and the air occupied 32 inches; by these and other experiments, made with different quantities of mercury in the same tube, similar results were obtained. We may, therefore, writes Mariotte, take it "pour une règle certaine, ou loi de la nature, que l'air se condense à proportion des poids dont il est chargé."

The truth of this law, he continues, may be more strikingly proved by taking an inverted syphon tube, one limb of which is 8 feet long and the other 1 foot, &c. He here proceeds to describe the construction and manner of using the instrument we have before mentioned as being that by the aid of which Boyle discovered the law.

It appears almost inconceivable that in sixteen years Mariotte should not have read the "Physico-Mechanical Experiments," in which we have seen Boyle so clearly suggested experiments on the subject in question, and it appears almost as inconceivable that in fourteen years§§

** There are several papers by Townley in the early numbers of the *Philosophical Transactions*, but not one of them relates to the subject in question; neither do I find mention of any paper by Townley on the subject, in Watt's "Bibliotheca Britannica."

†† The author of the article on Mariotte in the "Biographie Universelle" (1820) writes:—"Son discours sur l'air, qui parut en 1679 renferme une suite d'expériences intéressantes, alors absolument neuves." The "Nouvelle Biographie Générale" (1860), on the other hand, states that the essay appeared in 1676. In the preface to Mariotte's collected works it is stated that the essays "On Plants," "On the Air," and "On Heat and Cold," appeared between 1676 and 1679. In the text I have given Mariotte the benefit of the earlier date.

‡‡ See "Oeuvres de M. Mariotte de l'Académie Royale des Sciences." Paris, 1740.

§§ It will be remembered that the "Physico-Mechanical Experiments" appeared in 1660, and the "Defence against Linus" in 1662.

he should not have read the "Defence against Linus," containing not only the discovery of the law, but more elaborate experiments than he gives to illustrate and prove it. I find, however, no mention of Boyle's experiments in Mariotte's essay, at the same time he appears to be relating known facts rather than perfectly new and original experiments: it is curious, moreover, if he knew nothing of Boyle's experiments, that he should have used the same instrument, and directed it to be made of the same dimensions as those recommended by Boyle.

But allowing that Mariotte discovered the law independently of Boyle, is priority of discovery nothing? Do we not know that it is everything in the present day? And if now why not 200 years ago? Suppose a man were to discover a metal possessing, as he believed, properties different from those of any known metal, that he published an account of it, and that it proved to be cæsium, should we, in speaking of the discovery of the latter, couple his name with Bunsen's? Most assuredly not, however laboriously he had worked, however elaborately his research had been carried out. It is the duty of every man, before commencing a research, to find out how much has been done by other experimenters; if this were done more completely, what a large amount of controversial matter would be excluded from scientific literature.

It is true that 200 years ago there were less opportunities of ascertaining the results obtained by other experimenters than in the present day; there was so little physical science in the world, Nature had for so short a time been interrogated by experiments, that many philosophers had a habit of believing everything they discovered was new, and did not trouble themselves to ascertain the results obtained by others, but surely in fourteen years Mariotte might have made himself thoroughly acquainted with all the important discoveries which had been made relative to the air.

I trust, on consideration of the above facts, it will be conceded that the law which affirms that the volume of a gas varies inversely as the pressure to which the gas is submitted, is not "the law of Mariotte," but "the law of Boyle."

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Method of Determining the Amount of Alkaloids in Cinchona Bark, by Dr. J. E. DE VRY.

THE author has adopted the following process as one yielding the different alkaloids as they are contained in the bark, without alteration from the chemicals used for their extraction:—

The powder of the bark is dried at 212° Fahr., and the weight ascertained in the dry state. If possible, it is always preferable to use the same quantity. It is now mixed with a quarter of its weight of slaked lime, and this mixture boiled with ten times its weight of spirit of sp. gr. 0.85 during five minutes. The whole is now put into a filter, and exhausted by successive quantities of boiling spirit, making the whole quantity of spirit used equal to twenty times the weight of the bark. The alcoholic solution, after having been acidulated by dilute acetic acid, is evaporated on a water-bath till the alcohol has been expelled. The residue of the evaporation is now repeatedly treated with water till the filtered liquid is no longer rendered turbid by an alkali. The watery solution thus obtained contains all the alkaloids, whilst the quinovic acid, fatty and resinous matter, &c., remain upon the filter. If this filter, with its contents,

be treated with milk of lime, the quinovic acid can be determined. The watery solution of the alkaloids is next brought to a small volume by evaporation on a water-bath, and then mixed with an excess of slaked lime, by which the alkaloids are precipitated. The whole is now thrown upon the smallest possible filter and washed with a minimum quantity of cold water. If properly managed, the quantity of water necessary to remove the colouring matter is so small, that the loss of alkaloids by their little solubility in lime-water can be neglected; and if in a series of investigations care is but taken to work under the same conditions, as to size of the filters, &c., &c., the small loss before mentioned has not the least influence on the comparability of the results. After the filter has been properly washed it is dried and boiled repeatedly with alcohol of 0.82, till the alcohol dissolves nothing more. After filtration the slightly-coloured alcoholic solution is evaporated in a small weighed platinum vessel, and the residue heated on the water-bath until its weight ceases to diminish. The amount of the alkaloids in the bark is now known, and to ascertain the quality of the different alkaloids, they are dissolved in the smallest possible quantity of very dilute acetic acid. Sometimes there remains a trace of resinous matter undissolved, but in the majority of cases this trace need not be noticed. If, however, in an exceptional case the resinous matter is in such quantity that it can be weighed, its weight must be ascertained and subtracted from the amount of alkaloids. The acetic solution of the alkaloids is now placed in a closed funnel, provided with a cock, and agitated with a slight excess of caustic soda and a quantity of ether equal to fifteen times the weight of the alkaloids. After this agitation, the whole must stand at least six hours; for, although cinchonidine and quinidine are sparingly soluble in ether, a large amount of them is dissolved upon the first agitation, but is separated in crystals after a few hours. The ethereal solution is now evaporated, and the residue heated on a water-bath till its weight remains constant. This residue is quinine, containing traces of cinchonidine, quinidine, or cinchonine, and in many cases a large amount of the still unknown fusible alkaloid. By the known reactions of chlorine and ammonia, and by the preparation of *Herapathite*, the real nature of this residue can be ascertained. The alkaloids which have not been dissolved by the ether are now again dissolved in the smallest possible quantity of dilute acetic acid, and this solution mixed with a few drops of a concentrated solution of iodide of potassium. After stirring the liquid with a glass rod, there will appear a sandy crystalline precipitate if quinidine is present. In such case, the hydriodate of quinidine is collected upon a filter, dried at 212° Fahr., and its weight ascertained, whilst the amount of pure quinidine can be ascertained by calculation from the known weight of the hydriodate: 100 parts of hydriodate are equivalent to 71.68 parts of quinidine, according to the formula $C_{40}H_{24}N_2O_4, HI$. The liquid separated by a filter from the hydriodate is precipitated by caustic soda, and the precipitate noted as cinchonine, or as a mixture of cinchonine and cinchonidine, which depends upon special observations. If the solution of iodide of potassium produces no precipitate, the solution is precipitated by caustic soda, and the precipitate may be regarded as cinchonine, or as a mixture of cinchonine and cinchonidine. The presence of cinchonidine or quinidine among the alkaloids of a bark can be easily conjectured at the time of their treatment with ether; for if one of these alkaloids is present, it is partially deposited in a crystal-

line state after some time. Whilst the quinidine can easily be ascertained by iodide of potassium, even in small quantities, the presence of small quantities of cinchonidine can only be ascertained with certainty by the polarising apparatus, by which instrument I have, for instance, found the cinchonidine of Pasteur in the bark of *C. pahudiana*, of Java.—*Pharm. Journal*.

PROCEEDINGS OF SOCIETIES.

CHEMICAL GEOLOGY.

A Course of Twelve Lectures, by Dr. PERCY, F.R.S. Delivered at the Royal School of Mines, Museum of Practical Geology, Jermyn Street.

LECTURE XII. (Last of the Course).—Saturday, January 30.

(Continued from page 69.)

Sulphuretted hydrogen is found in some of the exhalations. Vapour issues from the Solfataras of Krisuvik in Iceland with sufficient force to project stones of the size of the hand to the height of several feet. Bunsen found this vapour to consist of 82.3 of steam and 17.2 of gas. You see how large a proportion of water is always given out. The 17.2 per cent. of permanent gas consisted of—

Carbonic acid	87.43
Sulphuretted hydrogen . .	6.60
Free hydrogen	4.30
Nitrogen	1.67

100.00

The composition of the gas was somewhat different at the point of issue, containing a smaller proportion of aqueous vapour and more carbonic acid. It is approximately estimated that this gaseous spring alone yielded during twenty-four hours 223 cubic metres of sulphuretted hydrogen (which is an enormous amount), 12 cubic metres of pure hydrogen, and a quantity of steam, the total effect of which would be equal to the power of thirty horses. Close to this spring was another nearly as large, which yielded gas of almost identical composition; and in a valley in the proximity numerous large pools of boiling mud, between which, we are informed, vapour breaks out with remarkable violence. Bunsen tells us that, although the small space of solid ground then surrounding it was continually covered with hot clouds of vapour, it was possible to penetrate to the openings from which the vapour issued by means of the crusts of gypsum which had been formed between the boiling pools, and to collect the gas for analysis. Note the fact of the formation of gypsum under these circumstances. He found the gas to consist mainly of carbonic acid and sulphuretted hydrogen. Here is the analysis of it:—

Carbonic acid	79.07
Sulphuretted hydrogen . .	15.71
Hydrogen	4.72
Nitrogen	0.50

100.00

The sulphuretted hydrogen seems to play an important part in the metamorphism of the adjacent rocks. As the resulting products have an acid reaction, owing to the oxidation of the sulphuretted hydrogen and the formation of sulphuric acid, they can contain neither carbonate of lime nor silica, and accordingly those bodies are never found in them. The acid would, of course, dissolve out the carbonate of lime, and, as there is no acid there to decompose the silicates formed, there would be no separation of silica. That is obvious enough. The sulphuric acid proceeds from the oxidation of the sulphuretted hydrogen, which, therefore, rapidly decreases, while the carbonic acid does not. In illustration, I may cite the composition

of gas taken from different small pools of the Solfatara of Krisuric:—

Nitrogen	1.80
Carbonic acid	88.54
Sulphuretted hydrogen . .	1.79
Hydrogen	7.87

100.00

Notice how large the proportion of carbonic acid is. The sulphuretted hydrogen, of which we had a large quantity in the former case, has been gradually removed by oxidation, forming sulphates, and so on, and reduced to 1.79. Then there is a gas in the "Acqua bollente," in Vulcano, one of the Lipari Islands, which has been examined by Deville, and found to contain an enormous proportion of sulphuretted hydrogen, larger than in any analysis I have yet seen recorded, namely, 82.8 per cent., with 9.8 of carbonic acid, and 6.8 of nitrogen.

Sulphur is another substance occurring in the exhalations of volcanoes. Volcanic eruptions are nearly always attended with the sublimation of sulphur, not only with the evolution of sulphurous gases, but with the actual sublimation of solid sulphur. Let us examine this point closely. According to Bunsen, deep down in the earth are masses of sulphur, of which, he says, "the occurrence may be easily accounted for by the action of volcanic heat upon decomposable sulphur compounds." It is to be regretted that this distinguished philosopher should not have specified those sulphur compounds which are reported to be thus capable of evolving sulphur when heated alone. There is one with which we are all well acquainted, which does evolve sulphur, namely, bisulphide of iron; but I am not aware that there are any other sulphur compounds which are likely to occur, or that there is any mass which will be decomposed by heat alone with the evolution of sulphur. The generation of sulphuretted hydrogen may be explained by supposing the contact of the vapour of water with metallic sulphides, when the metal would be oxidised, and the sulphur liberated in combination with hydrogen—a common experiment to make sulphuretted hydrogen. We pass the vapour of water, a compound of oxygen and hydrogen, over a metallic sulphide. The metal is thus oxidised, and sulphuretted hydrogen is formed, the sulphur of the metallic sulphide combining with the hydrogen of the water. Conversely, if sulphuretted hydrogen comes in contact with oxide of iron or other metallic oxides, either free, or combined as in basalt and silica, we get sulphurous acid and protosulphide of iron. You know that if the vapour of water is passed over metallic iron the iron is oxidised, and hydrogen is liberated. Conversely, when you pass hydrogen over a metallic oxide, that oxide is reduced to the metallic state. These reactions appear to be exceedingly probable, to say the least. That sulphur is evolved abundantly from volcanoes we know; and if it does not exist in a free state, it must, of course, be a product of decomposition. And, I ask, what is so likely to undergo that decomposition as protosulphide of iron arising from the action of steam at high temperatures? We know that steam is there, and sulphur must be there, and we know also that there is a temperature adequate to produce the result. Again, sulphurous acid and sulphuretted hydrogen, in contact, mutually decompose each other, with a formation of water and the deposition of sulphur; and there is no doubt that the free sulphur in many volcanic products, or in certain volcanic products, has been produced in this way—for instance, the free sulphur to which Bunsen has particularly drawn our attention in those pools of boiling mud. Admitting, for the sake of argument, the presence of accumulations or masses of sulphur, such as Bunsen refers to, the phenomena which are supposed consecutively to take place are—first, the contact of sulphur with red-hot pyroxenic rock, the iron of which becomes first converted into magnetic oxide,

with the evolution of an equivalent proportion of sulphurous acid; sulphide of iron is next generated; then follows the decomposition of that sulphide of iron by the action of steam at a high temperature. The metal is oxidised, and the sulphur liberated as sulphuretted hydrogen, which is resolved, in a greater or less degree, into hydrogen and sulphur, and hence occurs, as Bunsen observes, "the irregular, simultaneous exhalation of these gases, namely, sulphurous acid and sulphuretted hydrogen, at spots but little distant from each other in the same fumerole district. The sulphurous acid, whose appearance alone characterises the initial stage of all these phenomena, is accompanied for a while by sulphuretted hydrogen, which, by its reaction with the former gas, gives rise to that succession of decompositions which characterise the true solfataras. Acid liquors saturate the rocks traversed by separated sulphur, and torn up by aqueous vapour, converting these rocks, whether they belong to the pyroxenic or trachytic group, into clay, by extracting from the silicates entering into their composition, potash, soda, magnesia, lime, and protoxide of iron, and frequently a part of the alumina, as sulphates." The silicate of alumina is in the well-known plastic state of common clay. This is, no doubt, one way in which clay has been formed on a large scale. In the course of time this destructive action on the rocks is succeeded by a productive one, which increases in proportion as the source of sulphurous acid becomes extinct, and the gradually decreasing evolution of sulphuretted hydrogen recedes to greater depth. The acid reaction of the water is then succeeded by an alkaline one due to the formation of alkaline sulphides. Carbonic acid now acts upon the rocks, alkaline bicarbonates are formed, and silica is dissolved, which may be ultimately thrown down, as we have seen, in the form of Geyser structures. The appearance of springs of carbonic acid is the last stage of this series of metamorphic phenomena. The first effect of acid fumerole gases is the bleaching of the rock, due to the dissolving out of the oxide of iron. The rock becomes gradually disintegrated, until at length there remains nothing but a plastic argillaceous mass comparatively free from iron. The collateral products are crystals of iron pyrites, hyalite, hydrated oxide of iron, and anhydrous red oxide of iron. Some difficulty may occur to you in explaining how this anhydrous red oxide should be generated. Bunsen asserts—and I believe he is right—that it is formed by the long-continued action of boiling in these ferruginous mud pools. Occasionally we find gypsum, of which I have spoken several times, and carbonate of lime produced under these conditions.

Bunsen explains especially—and this, I think, is one of the most interesting parts of his papers—how gases penetrating a rock along with aqueous vapour may completely metamorphose the substance of that rock on the spot, without any removal of the products of decomposition; and he illustrates his explanation by examples, and supports it by chemical analyses. To this kind of action he applies the very appropriate term "pneumatolytic." He maintains that even a zeolitic amygdaloid, full of cavities containing zeolites, which occurs abundantly in Iceland, is only a variety of trap metamorphosed on the spot, without the removal or deposition of any further matter. He advances, in support of this view, the fact that one passes by insensible gradations into the other, and that the average composition of the amygdaloid rock—abstraction being made of the water it contains—is identical with that of the trap. However this may be, I may mention that from other experiments or other statements he has made, we have indisputable evidence that all zeolites are not so produced. Bunsen makes a very sweeping statement with regard to zeolitic formations, which I think by no means justified, and which is in opposition to facts which have come to light since his statement was made.

Nitrogen is a constituent of volcanic gas, but its pro-

portion varies much. Bunsen found 81.81 per cent. in the gas from a fumerole in the great crater of Etna.

Free oxygen occurs only as an occasional constituent in the published analyses of volcanic gases. Along with the 81.81 per cent. of nitrogen in the gas from the great crater of Etna Bunsen found 14.21 per cent. of free oxygen. In the gas of non-acid fumeroles Deville found the proportion of oxygen relatively to the nitrogen to be 20.8, and in the acid fumeroles 19.7. This shows that in the acid fumeroles a little oxygen had been abstracted, for the proportion was sensibly less than that existing in the other case. This was easily accounted for by the generation of sulphuretted hydrogen and the evolution of oxygen in consequence.

Ammonia is often evolved, but in combination with hydrochloric acid, and condenses in the solid form of sal-ammoniac. Mineralogical cabinets often contain specimens of this. Some months after the eruption in 1846, Bunsen tells us he observed the lower part of the lava stream studded over with smoking fumeroles, "in which (he says) so large a quantity of beautiful crystallised muriate of ammonia was undergoing a process of sublimation that, notwithstanding the incessant torrents of rain, hundreds of pounds of this valuable salt might have been collected." Its production was limited to the zone in which meadow land had been overflowed with lava; and higher up the muriate of ammonia and the last traces of vegetation ceased together. Hence, he infers that the ammonia is derived entirely from the organic matter of the soil. Ammonia is a constituent of the vapours evolved from the suffioni of Tuscany, and Liebig believed that it was not of organic origin, but was an original constituent of the earth's crust, on the ground that the temperature of the vapour was so high that it must have come from depths where "neither man nor animals could ever have lived." It was, however, urged in reply to that, that the hot vapour must have traversed sedimentary rocks above, in which, no doubt, organic residue was contained, and, therefore, Liebig's theory falls to the ground.

It is still a disputed point whether flame ever accompanies volcanic eruptions; but if hydrogen be evolved, which there is no ground for disputing, there is no reason, considering the high temperature, why flame should not be produced. The flame of hydrogen is very feebly luminous, and might possibly not be easily recognised in the bright glare of molten lava.

I have now passed in review some of the more important chemical phenomena connected with volcanic action, and you will naturally ask, to what conclusion do they lead concerning the causes of this action?

The amount of heat required to fuse such enormous masses of lava—veritable mountains of lava—as have been known to be ejected in a single eruption, is very great. I speak now of the *amount* of heat,—of the amount merely. The temperature, however, or, in other words, the *intensity* of the heat, need not be extremely high, as we can, without difficulty, melt various kinds of lavas or basalts in our ordinary furnaces. The question as to what is the source of this heat is one of intense interest. That is the main point for inquiry. Setting aside the hypothesis of central fusion, resulting from oxidation or other causes, is there reason for supposing subterranean chemical reactions, such as Davy suggested? This philosopher, it will be remembered, imagined that the alkaline and earthy metallic bases might be present deep below the surface of the earth, in a free state; but this would involve the evolution of an enormous quantity of hydrogen, but there is no proof, so far as I know, of evolution to anything like that extent. After a careful review of all the phenomena of volcanic action with which I am acquainted, I must say that I have failed to discover satisfactory evidence to justify belief in the chemical hypothesis.

With these remarks, ladies and gentlemen, I take my leave of you for the present.

LECTURES ON CHEMICAL PHILOSOPHY.—III.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 70.)

IN conformity with the law first enunciated by Ampère we have laid down the two following principles:—

1. That equal volumes of a gas or simple vapour contain the same number of atoms.
2. That equal volumes of compound gases and vapours contain the same number of molecules.

It follows that the atom answers to 1 volume, and the molecule answers to 2 volumes; and that if we bring the densities into relation with that of hydrogen taken as unity, the atomic weights (or 1 volume) are given by the densities, and the molecular weights (or 2 volumes) are given by the double densities.

Let us establish by some examples the help which these laws relative to densities give us in fixing the atomic weights.

Let us take, for instance, carbonic acid CO_2 . Its density (see page 70) = 1.529. If we multiply 1.529 by 28.88 (see page 70) we shall have 44, which is the weight of 2 volumes of carbonic acid; hence 44 is the molecular weight of carbonic acid. But the most simple view we can take of the composition of carbonic acid obliges us to admit that 2 atoms of oxygen are combined in it with 1 atom of (vapour volume) carbon. The two atoms (volumes) of oxygen weighing 32, the atom of carbon should weigh 12; 44 in fact represents $32 + 12$, and 44 is exactly the sum of 2 atoms of oxygen and 1 atom of carbon.

Experiment has demonstrated, and Gerhardt has proved, that in all reactions the weight of carbonic formed is never less than 44; 44 then is the smallest quantity of carbonic acid which can exist free or be withdrawn from a compound. It is, therefore, the weight of the carbonic acid molecule.

In the same way, we find that the molecular weight of water is 18, and not 9. Its atomic formula is, therefore, $\text{H}_2\text{O} = 18$. Gerhardt, in fact, has also shown that the smallest amount of water which can be generated in any reaction is represented by 18 if 1 atom or 1 volume of H weighs 1.

Among the metals let us take mercury as the example, and see how we derive its atomic weight from the molecular weight of mercuric chloride, as it is given by the density of the vapour of the chloride. This density = 9.8. If we multiply by the double co-efficient 28.88 we have 283, which represents the molecular weight of the vapour of the chloride: 283 represents the atomic weights of the elements of the molecule. But the most simple hypothesis we can form is to consider the molecule of corrosive sublimate as containing 1 atom of mercury. According to the law of Dulong and Petit, the atomic weight of mercury is equal to 200, and this number is confirmed by the density of the vapour of sublimate. In fact, 283 of sublimate contain 200 of mercury; the remainder represents the weight of 2 atoms of chlorine. The molecular formula of corrosive sublimate is, therefore, HgCl_2 , in which H represents 200 of mercury.

We must now examine the exceptions to the laws of Dulong and Petit, and of Ampère, alluded to in the last lecture.

As regards the first, we have said that carbon, boron, and silicium are in complete disaccordance with the law—that is to say, when we multiply the atomic weights of these bodies by their specific heats we do not obtain a constant product.

We might dispose of this anomaly at once by remarking that these bodies may have several different atomic weights. This proposition may seem strange at first sight, but there are some chemical facts which may lead us to suppose it correct.

Sir B. Brodie, by means of a mixture of sulphuric acid, chlorate of potash, and graphite, has succeeded in forming

a solid, yellow, highly carbonated acid, containing, according to his opinion, carbon in the form of graphite. Analysis leads him to consider 33 the atomic weight of the carbon in this compound. He has formulated this graphitic acid $\text{Gr}_4\text{H}_4\text{O}_5$. Besides this, the number 33 is deduced from the specific heat of graphite.

Carbon, which exists in several different allotropic states, seems, then, to be constituted of several distinct atomic aggregations. Boron and silicium appear to offer an analogous heterogeneity. Perhaps the secret of the exceptions to the law of Dulong and Petit may be found in this fact.

Among the simple bodies there exist four exceptions to the law of Ampère. These are phosphorus and arsenic on the one part, and cadmium and mercury on the other. The vapour densities of the first two are twice too high, and those of the two others are twice too low.

Until recently there was another anomaly. The vapour density of sulphur taken at 500° was three times too high. It was 6.6, which corresponds to 3 atoms S_3 . But MM. Bineau and H. Deville have found that at 1000° it becomes 2.2—a number in perfect accordance with the law of Ampère.

It is possible that the vapours of phosphorus and arsenic may also split up or become loosened at very high temperatures. We have not yet succeeded in effecting this *loosening*, and it is possible that it can only be produced at temperatures much higher than we can reach.

The vapour densities of mercury and cadmium are twice too low. We may interpret this fact by comparing these metals with certain organic radicals which offer a similar peculiarity. We shall presently return to these considerations.

It is only, however, the atomic weights derived from the vapour density of phosphorus and arsenic which are double those which chemical processes assign to them. They express in reality the molecular weights of these two bodies.

The chemical atomic weights of mercury and cadmium are identical with the molecular weights deduced from the vapour densities. In other words, the atoms of gases and vapours correspond to 1 volume, while those of phosphorus and arsenic correspond to $\frac{1}{2}$ a volume, and those of mercury and cadmium to 2 volumes.

We pass on to the exceptions which the vapour densities of compound bodies present. The vapour densities of sal ammoniac, perchloride of phosphorus, and sulphate of hydrogen,* and some other bodies are twice too little. The molecules of these bodies, instead of representing 2 volumes, represent 4 volumes.

Gentlemen, when we find ourselves face to face with a great fact—a fact which appears universal in its application,—with a great law, in a word,—if exceptions appear, it is not necessary to give up the law, but we must endeavour to confirm the law by the exceptions. We must interpret the fact in a sense favourable to the law.

Well, as regards the exceptional compounds with which we are now concerned, MM. H. Kopp, Cannizzaro, and Kekulé have thought that at the temperature at which we take the vapour densities of these bodies, their molecules no longer subsist, but are split asunder,—the perchloride of phosphorus, for example, into chlorine and protochloride, and sal-ammoniac into hydrochloric acid and ammonia. This decomposition is not permanent, but, as the temperature becomes low, the original compound is reconstituted, so that no trace of the *dissociation* remains.

The explanation is ingenious; but how can we demonstrate the truth of it? A chemical process designed to prove the existence of a mixture by causing the absorption of one of the mixed gases is inapplicable, seeing that a new body introduced into the gaseous mixture may act on the mixture by its affinities, and so set up a disturbing

* We translate literally, but it may be necessary to inform some readers that the lecturer means sulphuric acid.

influence. We must then have recourse to physical proofs, and among these *diffusion* seems to be most appropriate.

Diffusion has been tried. M. Pebal has diffused the vapour of sal-ammoniac (at 350°) in a tube full of hydrogen, and he has found that after the diffusion the lower part of the tube contained hydrochloric acid. There was then a mixture.

MM. Wanklyn and Robinson have diffused the vapour of sulphate of hydrogen and perchloride of phosphorus, and they have observed that at a high temperature decomposition took place, and there was, consequently, a mixture.

The question seemed to be decided, and the hypothesis of Kopp and Cannizzaro demonstrated, when some new experiments by H. Deville reopened the discussion. This eminent chemist discovered that bodies may decompose at a lower temperature than that of combination; that pure water, for example, in small quantities may decompose at a lower temperature than that which determines the combination of hydrogen with oxygen, and lower than that at which water decomposes in bulk. Hence he concludes that bodies possess at lower temperatures than their points of decomposition a tendency to decompose or to *dissociate*. And he supposes that in the experiments of Pebal, Wanklyn, and Robinson the decomposition of the compounds amounted to this, that even below 350° dissociation of small quantities of the salt took place, sufficient, however, to give rise to the phenomena of diffusion.

Devil made a still more decisive experiment. Having taken hydrochloric and ammoniacal gas, and heated them to 350°, he found that when a mixture was made the temperature rose to 394° in consequence of the combination of the two gases; and he concluded, therefore, that hydrochlorate of ammonia may exist in a state of vapour even at 394°.

The argument of Deville against the explanation of Cannizzaro may be reduced to this:—Sal-ammoniac really exists at 350°, since its elements, when brought together at this temperature, disengage heat.

These propositions, evident as they appear, are still open to one objection. Is the disengagement of heat always the index of a reaction—the proof of the formation of a new molecule? The experiments of M. Favre on the thermic effects of mixtures seem to prove the contrary. Having mixed water with sulphate of hydrogen considerably diluted, he observed the disengagement of heat: he observed the same thing on adding small quantities of water to concentrated solutions of certain salts, retaining their water of crystallisation. In such cases the disengagement of heat cannot be due to affinity; it must be due to some attraction differing from affinity. Why, then, may not the molecules of HCl and NH₃ at 350° exercise some mutual action causing the disengagement of heat, and still not be blended into a single molecule? Clearly, we may be allowed to believe that known facts justify a different explanation from that of M. Deville.

We now come to a point of the greatest importance—that of the true constitution of simple bodies. Simple bodies are compounds of molecules which represent two volumes, and which contain two atoms. Thus the molecule of hydrogen, the smallest quantity which can exist free or enter into a combination, is formed of two atoms of hydrogen, is H₂ or a hydride of hydrogen. It is the same with chlorine, iodine, bromine, oxygen, and, indeed, the greatest number of simple gases and vapours. In the reaction of chlorine on hydrogen we have



and after the reaction



There has been, then, not combination, but double decomposition; for each volume of hydrochloric acid must contain one atom of hydrogen and one atom of chlorine, which is as much as saying that a molecule of hydrogen must have been halved. Such is the starting point of the

theory we now proceed to establish, supporting it by chemical and physical considerations.

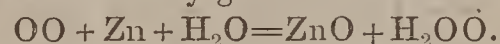
Let us first look at hydrogen. Suppose we take hydride of copper CuH, and drop it into a test-tube containing hydrochloric acid: cuprous chloride is formed, and there is a violent disengagement of hydrogen. But hydrochloric acid is not decomposed by copper, and how could it be by a compound of copper and hydrogen, unless the affinity of the copper for the chlorine was assisted by the affinity of the hydrogen for the hydrogen? The reaction is clearly $\text{CuH} + \text{HCl} = \text{CuCl} + \text{HH}$.

We may say in the same way that free oxygen is an oxide of oxygen, and that the molecular weight of the body is 32=2 atoms—a fact which the experiments of Clausius oblige us to admit.

MM. Favre and Silbermann have shown us that the combustion of carbon in protoxide of nitrogen disengages more heat than the combustion of the same body in oxygen. This, at first sight, very singular result is easily explained if we admit the duality of the molecule of oxygen. In both cases there is a decomposition, and the decomposition of the protoxide of nitrogen N₂O requires less heat than the decomposition of OO, and that is why the total heat produced is least in the latter case.

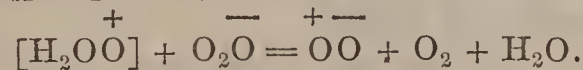
We know that oxygen and nitrogen combine in the eudiometer with difficulty, but if we add hydrogen to the mixture an appreciable amount of nitric acid is formed. We have in this case HH, OO, and N; at first there is formed (HH)O, and so the molecule of oxygen is halved, and the atom in the nascent state combines easily with the nitrogen.

Schönbein, on allowing water to fall drop by drop upon a plate of zinc, found the water to become charged with a small quantity of peroxide of hydrogen. How can we explain the formation of this substance under these circumstances? Our theory gives us the reason:—



OO is decomposed; one of the atoms oxidises the zinc, the other in the nascent state unites itself with the H₂O.

The remarkable reductions effected by oxygenated water come in to support our theory. Thus, oxide of silver is reduced to the metallic state; permanganate of potash is changed into manganic hydrate with the evolution of oxygen; and ozone is brought back to the state of ordinary oxygen. All these facts and many others, which have been for a long time explained by the action of simple contact—an action altogether incomprehensible—are much more easily explained on the supposition of the duality of the molecule of oxygen. We have, in fact, the following changes:—



Ozone.

Similar considerations will prove that the principle extends to other simple bodies. We may say, then, that the molecules of a great number of simple bodies, like those of compound bodies, represent two volumes, and contain at least two atoms.

ACADEMY OF SCIENCES.

August 4.

M. BOUSSINGAULT contributed a paper “On the Nitre Beds of Tacunga,” in the State of Ecuador. Saltpetre, he remarks, is distributed in nature with astonishing profusion. It is found in rain, in snow, in hail, in dew, and in fogs; it is present in the water of rivers, and consequently in the ocean. It is found in the air, and in the earth. Whenever combustion takes place in the atmosphere there is generally some oxidation of nitrogen and some nitre compound

formed. Nevertheless, the proportion is extremely minute. The localities in which it is met with in abundance are very few, and in only one it forms a distinct layer, namely, in the province of Zarapaca, in Peru. Besides this the salt appears spontaneously under very different circumstances, all, however, indicating the intervention of organic matters. Sometimes it covers the soil with efflorescences which develop like a rapid vegetation. A few days ago the earth may have been black and moist, to-day it is white and pulverulent. The saltpetre may be removed by washing the soil, and if the meteorological conditions remain favourable a second crop may soon be gathered. It is thus that nitre is obtained from the soil deposited by the inundations of the Ganges, and in some parts of Spain.

The conditions under which natural nitre beds occur, too, are very different. They are found in full sunlight on cultivated lands, in the shade of forests, and in the darkness of caverns. But in all cases the same agents produce them, organic matters, humus, and the same phenomenon takes place, slow combustion, and the oxidation of a small amount of nitrogen from the atmosphere. Dry air and long immunity from rain seem to be indispensable conditions, and also the presence of the *detritus* of crystalline rocks to furnish the alkali. Wherever natural nitre beds are found the felspathic elements are always present.

The arable land of Tacunga is a fine sand, consisting of particles of trachyte and pumice coloured with humic matter. Some days after the rains cease the soil becomes covered with an efflorescence, which, as soon as it becomes thick enough, is removed and washed to extract the saltpetre.

M. Boussingault thought it of interest to examine the soil after the removal of the efflorescence, to ascertain what concurred in the process of nitrification. These were taken for him at several places and various depths. We need not quote the whole of his analysis; it will be sufficient to say that a cubic decimetre of the soil, weighing 1200 grammes, contained 0.12 grms. of ammonia in the state of fixed salts; 11.70 grms. of nitric acid representing 21.91 grms. of nitrate of potash; 2.92 grms. of nitrogen in organic matters, forming a sort of reserve for the production of nitric acid or ammonia.

The author finds a curious analogy between the constitution of this earth and that of the best cultivated lands, and believes there is a real connexion between fertility and nitrification. This is not the first time we have published M. Boussingault's views on nitrification, but we may quote his closing paragraph. The origin of nitric acid in natural nitre beds, he says, resides in the slow combustion of azotized organic matters analogous to humus, and the brown acids of fertile soils—an origin very different from that of the nitric acid formed in the atmosphere (which is also an immense nitre bed) by the electric spark, and by the mysterious action of ozone.

M. Millon, who agrees with M. Boussingault as to the origin of nitre, had also a paper on "*Nitrification in Algeria*." M. Millon looks on Algeria as having a climate favourable for the production of nitre in artificial beds; and he has made some experiments which strikingly confirm his view. He started with humus prepared artificially from wood, charcoal, or sugar, mixed this with vegetable and animal matters from the towns, and cautiously moistened the mass. In a few days he found nitre in the upper part of the mass, and observed that the quantity diminished the lower he went down. The climatic conditions of Algeria seem highly favourable to nitrification, and the author recommends that the country should be made a great nitre bed.

In a paper on the "*Hydrocarbons of Coal-tar*," M. Beilstein announces his belief that the new hydrocarbon discovered by MM. Bechamp and Naquet is pure *xylene* C_8H_{10} . This body has been studied by Mr. Church and Dr. Müller, who differ about its boiling point, the former

asserting that it boils at 126.2° and the latter at 140° . Beilstein confirms the experiments of Dr. Müller both as regards the boiling point and the compound obtained by reducing tri-nitro-xylene by means of sulphuretted hydrogen. Xylene may be obtained by collecting the product, which passes about 140° . It is purified by treatment with fuming sulphuric acid, which dissolves it, forming xylene-sulphuric acid. This is decomposed by heat, and pure xylene distils at 139° .

We have noticed from time to time the ideas which have been published on the propagation of contagious diseases by living ferments. MM. Leplat and Taillard now come forward with a paper "*On the Action of Bacteria on the Animal Economy*." They have produced these beings in vegetable infusions, in liquids charged with decomposing animal matters, and in decomposed serum of blood, and have then injected the fluids into the veins of dogs, but they never found the animals any the worse for it. In one case, however, a large quantity of decomposing serum of ox blood killed a dog with dysenteric and convulsive symptoms, but the blood of this animal injected into the jugular vein of another produced no effect.

M. Perrin has experimented "*On the Influence of Alcoholic Drinks taken in Moderate Quantities on Nutrition*." He found that less carbonic acid was exhaled from the lungs when wine was taken. His estimations of urea showed nothing particular. He believes with Dr. Smith and others that alcohol is not assimilated, but it affects nutrition by lessening the expenditure of material.

A recent *Comptes Rendus* contained an account of a French smuggler who was made very ill by carrying tobacco under his clothes. M. Gallavardin now contributes a paper "*On Poisoning by the Application of Tobacco-leaves to the Skin*," in which he quotes several cases of poisoning by this means;—not fatal cases, however. We can supply him with another. We once saw a man brought out of the London Docks dead, with a large quantity of tobacco-leaves under his shirt and in his trousers. He was said to have been poisoned by rum, but the tobacco may have had something to do with his death.

NOTICES OF BOOKS.

The Chemical Processes of the British Pharmacopœia, and the behaviour with Reagents of their Products. By HENRY J. CHURCH, M.P.S. London: Hardwicke. 1864.

It has been a matter of some surprise to us that no work has appeared on the British Pharmacopœia of the same character as Mr. Phillips' translation of former London pharmacopœias. There is yet room for such a work, since pharmacists, and more especially the pharmaceutical student, is still left without a complete guide to the Pharmacopœia.

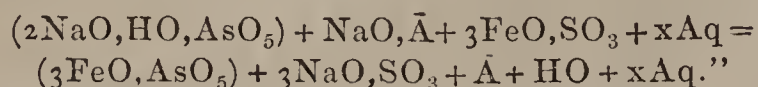
The work we now notice partly supplies the want we have indicated; but it is restricted entirely to an explanation of chemical processes. As such, however, it will be of great service to the pharmaceutical student, and we have much pleasure in recommending it. The following is a sample of its contents:—

"Ferri Arsenias.—Arseniate of Iron $3 Fe O, As O_5$, partially oxidated.

"Three ounces of Acetate of Soda, and four ounces of Arseniate of Soda, dried at 300° , are dissolved in two pints of boiling Distilled Water, and nine ounces of Sulphate of Iron are dissolved in three pints of Distilled Water. The solutions are mixed, and the white precipitate collected on a calico filter, and washed until the washings cease to be affected by a dilute solution of Chloride of Barium. The washed precipitate is squeezed between folds of linen in a press, and dried in a hot-air chamber under 100° .

"The officinal Arseniate of Soda consists of two atoms of Soda and one of Water as base; that the result of its

decomposition with Sulphate of Iron may be a basic Arseniate of Iron, another salt of soda must be laid under contribution for an atom of soda to take the place of the basic atom of water. The Acetate of Soda is chosen for this purpose, and when this and the arseniate of soda, both in solution, are added to the solution of Sulphate of Iron, the reaction is this:—



At the end of the work the chemical substances of the *Materia Medica* are arranged in groups, and their reactions are succinctly given. As we have said, this will be a useful book to the pharmaceutical student.

*International Exhibition. Jurors' Report. Class II.,
Section A. Industry of Manures.*

IN our notices of Dr. Hofmann's Report on Class 2, Section A, of the Exhibition, we referred incidentally to this chapter on manures, and announced our intention of leaving it for future consideration. The time is come when we may take up the subject, and give our readers the substance of this, in some respects, remarkable essay.

We may state that this portion of the Report must be looked upon as a distinct work, the production mainly of Mr. F. O. Ward. Much special information communicated to the general author of the Report has been incorporated, and the whole has received the full approval of Dr. Hofmann. We have therefore to look upon the document as expressing the opinions of Mr. Ward endorsed by Dr. Hofmann.

It is not our intention to enter upon any detailed criticism of the essay, which, it must be remembered, is devoted as much to the philosophy of manuring as the industry of manures. We have recently (in a series of papers on the "Chemistry of Agriculture" in vol. vii. CHEMICAL NEWS) discussed some of the questions here debated, and need not now re-enter upon the discussion. We shall therefore content ourselves with laying before our readers the substance of the Report and the conclusions at which the reporters have arrived.

The first part is historical. Manures in the form of cattle-dung and farmyard composts have been used from time immemorial; but the manures termed "artificial," which have their origin elsewhere than in the farm, have but of late years come largely into use. The British patent-rolls, the Report states, record the grant previously to 1800 of only three patents for manures, dated respectively 1721, 1729, and 1773. This, though a matter of small importance, is a mistake. Six patents were granted in the eighteenth century, of four of which the specifications are printed. Of the other two it would appear that no specifications were enrolled. Most of these are mixtures of common salt and lime; but one by Charles Neville, dated 1744, makes use of "cockle, oyster, and other sea-shells, burnt in a kiln with coals, wood, or any other fuel, but not quite so much burnt as for lime."

The specification of Baron von Hake, dated 1779, it is remarked, affords a rough measure of the state of popular knowledge and opinion on the subject of manures towards the end of the last century. The Baron made a composition, which, to use the words of the specification, "consists chiefly of common salt, which is melted in an oven (made for that purpose) by a large coal fire until it is dissolved as thin and as fluid as water; then the same is fixed with saltpetre (which receives from the air a magnetic power, and communicates the same to the fluid), salt of unslaked lime, and salt of Rhenish tartar. When the said composition (so invented, found out, and prepared) becomes of a magnetic quality whereby it attracts fertility, and is (as aforesaid) productive of the effects of manuring arable land, meadow, and pasture ground." The last manure patent of the last century, taken out by the Earl

of Dundonald in 1795, is for the use of sulphates and sulphurets of the alkalies.

The first patent of the present century was for dried excrement, and then comes another for pounded oyster-shells, gypsum, and heavy spar. After that, we have no other for thirty years, when we come (1835) to the patent for the well-known "Poudrette." From this time forward the patent rolls teem with manure patents, all but two, however, dated since 1840, the year in which Liebig published his work on "Organic Chemistry in its Applications to Agriculture and Physiology."

"The impulse given by Liebig's first book to manurial industry is very distinctly traceable in the registry of British patents.

"During the ten years which followed its publication, *i.e.*, between 1840 and 1850, no less than thirty six patents for manurial processes and products were enrolled; being six times as many, in ten years, as had been obtained in all preceding time since patents were first granted.

"During the next five years this manurial movement went on in an accelerating ratio; no less than ninety-six more patents having been registered between 1850 and 1855. The lowering of the charge for patents, which occurred during this interval, no doubt had its share of influence on this result.

"The patent statistics since 1855 are not before the Reporter; but he is enabled to state, in general terms, that the activity of research and invention in this department has by no means declined during the last seven years, and that the manurial inventions brought forward in England since 1840 may be approximatively estimated as numbering at least 200.

"This long series of inventions comprises plans and processes for turning to account, as manure, almost all the known forms of animal waste and ejecta; such as, for example, the night-soil and sewage of towns; the rags of woollen, silken, and leathern clothing; the *débris* of manufactures in which horn, bone, hides, bristles, gut, and other organic and nitrogenous materials are used; the spent animal or bone-charcoal of the sugar refineries, and other phosphatic residua; the ammoniacal liquors of gas-works; the alkaline wash-waters of soap, dye, bleach, and many other factories; in a word, several hundred forms of residua—nitrogenous, phosphatic, and alkaline—formerly cast away as worthless rubbish.

"These the respective patentees propose to subject to various processes, mechanical, physical, and chemical; such as, for example, in the case of liquors, to concentration by boiling down, or precipitation by chemical agency; in the case of solid residua, to crushing, grinding, or other process of comminution; or to chemical disintegration by powerful solvents, acid or alkaline, according to the circumstances in each case; or to maceration in water; or to torrefaction by fire; or to digestion, at low or high pressure, sometimes in moist, sometimes in dry or superheated steam.

"Several of the patents include recipes for mixing the products thus obtained with each other, or with products of a different origin, to adapt them (as the inventors allege) for special crops, or for peculiar soils.

"Many of these proposals possess merit; though a still larger number exhibit ignorance on the projectors' part, while a certain percentage almost seem to have been concocted with a view to profit by the ignorance of others."

We must return for a moment to the predecessors of Liebig. Although the researches of many chemists bore more or less directly upon manurial and agricultural questions, there were two whose investigations and writings contributed immediately to the advancement of our knowledge of the subject. These were Lavoisier and Davy, and we may extract at length the eloquent passage in which the Reporter alludes to the influence of these two great men:—

"Among the many illustrious men who assisted Lavoisier

probably deserves the highest place; not, perhaps, as the largest contributor of new truths to the accumulating store—though his contributions of this kind were many and brilliant—but because his vivid imagination, and the eminent generalising powers with which he was endowed, enabled him to co-ordinate all the scattered researches of his time, and to display innumerable isolated facts in their true subserviency to general laws; so as (among other things) largely to extend our knowledge of the cosmic equilibrium on which sound husbandry can alone be based. Everything, indeed, that Lavoisier did, bore the impress of his master-mind. He it was who first applied the Balance to the study of the phenomena of Life. He it was who first showed that, while plants evolve oxygen, animals, on the contrary, consume it; carbon being oxidised or burned in their bodies as oil is burned in a lamp. His lofty tone of thought, and eloquent language, powerfully impressed his contemporaries; and chiefly to his influence and example the admirable researches of his age owe their high scope and scrupulous precision. Science never endured a severer loss than when Lavoisier met his untimely fate. But his great spirit 'lived after him,' and researches bearing upon the noble themes he had loved to treat were carried on, if possible, with increased activity after his death. The scientific records of Europe were soon crowded with fresh masses of undigested discovery; and in a few years such another mind as his was wanted, to grapple with the growing mass of detail, and once more to create order out of the scientific chaos.

"Early in the present century, England, in her turn, produced a master-mind—that of the illustrious Sir Humphry Davy—vast in scope and luminous in conception, as any, the greatest, of foregone times. Davy was well fitted to wear the fallen mantle of Lavoisier, and to continue his great work. It is, accordingly, to Davy's genius we owe that memorable treatise—truly described by Liebig as 'immortal'—the 'Elements of Agricultural Chemistry.'

"In that imperishable work all the scattered results of foregone research in this branch of science were collected and reduced to a system, which was extended and enriched by the author's own capital researches; whereof, perhaps, the most signal (in this department of science) were his analytical investigations of soils (types of all that has since been done in that way); his capital determinations of the composition and transformations of vegetal products; and his admirable experiments on the nutrition of plants, as well by leaf as by root.

"To the powerful impulse and just direction impressed by Lavoisier in France, and by Davy in England, on subsequent investigations of like kind, may be ascribed in a great measure their vigorous and successful prosecution by philosophers contemporary with ourselves."

Without denying to Lavoisier the honour of being the greater genius—perhaps the greatest chemical genius who has lived—we think we may still claim for Davy the honour of being the father of agricultural chemistry.

(To be continued.)

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1642. Thomas Nichols, New York, U.S.A., "Improvements in the preservation of eggs, and in apparatus to be used in connection therewith."—Petition recorded July 1, 1864.

1688. William Edward Newton, Chancery Lane, London, Middlesex. "An improved process for cleansing or clarifying impure water."—A communication from Carl Johann Auguste Scheerer, Freiberg, Saxony.—Petition recorded July 7, 1864.

1766. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of fluoride of

silicium."—A communication from Cyprien Marie Tessié du Motay and Edouard Karcher, Saarbruck, Rhenish Prussia.—Petition recorded July 14, 1864.

Notices to Proceed.

713. John Morgan, Stephen's Green, Dublin, "Improvements in the preservation of animal and vegetable substances, and in the fluids to be employed therein."—Petition recorded March 21, 1864.

745. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in washing apparatus."—Petition recorded March 24, 1864.

955. James Cane Coombe, Swinton Street, Gray's Inn Road, Middlesex, "Improvements in the preparation of fertilising agents for agricultural, horticultural, and other analogous purposes."—Petition recorded April 15, 1864.

1072. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment and application of sea-weed."—Petition recorded April 28, 1864.

CORRESPONDENCE.

Cavendish Society.

To the Editor of the CHEMICAL NEWS.

SIR,—Will you inform me through the medium of your Notices to Correspondents whether the 16th vol. of "Gmelin's Handbook" by the Cavendish Society is yet published? It was promised to be issued a month or so after the general meeting, but up to the present time I have heard nothing of it, although I am a subscriber.

I am, &c. "RUMEX PATIENTIA."

August 6, 1864.

[We publish this as a specimen of several communications we have received. We have not seen the volume.—ED. C. N.]

Equivalent of Indium.

To the Editor of the CHEMICAL NEWS.

SIR,—In the paper on "Relations Between the Equivalents," published in your journal of the 30th ult., Mr. Newland states,—"We may almost predict that the next equivalent determined—that of indium, for instance—will be found to bear a simple relation to those of the group to which it will be assigned." Will Mr. Newland be kind enough to give us some idea of the equivalent of this new metal?

I am, &c.,

INQUIRER.

London, August 9.

MISCELLANEOUS.

A New Complaint against the Pharmacopœia Committee.—Another peculiarity in the British Pharmacopœia is the complete ignoring of the United States as a commercial source of drugs, which is intensely English. For instance, Guaiac wood is referred to St. Domingo and Jamaica; kino to Malabar; rhatany to Peru; jalap to Mexico, but tobacco is cultivated in America. Serpentaria from the southern parts of North America; whilst senega, sassafras, podophyllum and lobelia are all attributed to North America, and Canada balsam, which is specially North American, is referred to Canada! It follows from this that, in British geography, North America is a country identical with the United States!—*American Journal of Pharmacy.*

ANSWERS TO CORRESPONDENTS.

Ph.D.—You are correct. It should have been *M.D.* after Dr. Muspratt's name in our last, not *Ph.D.*

A Reader.—The word "alcohol" was used to signify an impalpable powder, as well as spirit of wine.

J. Newlands--Studiosus.—Received. Will appear next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Combinations of Metal Ammonium,
by W. WEYL.*

THE author seeks to explain how far ammonia may be reconciled with the existence of ammonium, his arguments being greatly strengthened by a new ammonium which he has succeeded in producing, and also by the mode of its formation and decomposition.

In starting he sought to obtain a mercuric oxide of ammonium, and to use this for the production of other compounds with electro-negative bodies. When dry ammoniacal gas, under pressure, is made to act on yellow oxide of mercury, a chemical compound is formed, containing 4 equivalents of oxide of mercury to 1 of ammonia; when prepared in perfect exclusion of light, it is of a yellow colour similar to the oxide itself; light renders it paler, and when dissolved in hydrochloric acid leaves a small portion of calomel undissolved; long exposure to light even leaves metallic mercury. In the air this new compound rapidly absorbs carbonic acid, and loses ammonia, the same taking place over sulphuric acid. Rapidly heated in a flame it becomes brown and explodes most vehemently; but by a very careful and gradual rise of temperature even 30 grains might be decomposed without explosion. If the three atoms of hydrogen in this body could be combined with the corresponding amount of oxygen and the product removed as water, an ammonium mercury would be left, wherein mercury had replaced the hydrogen.

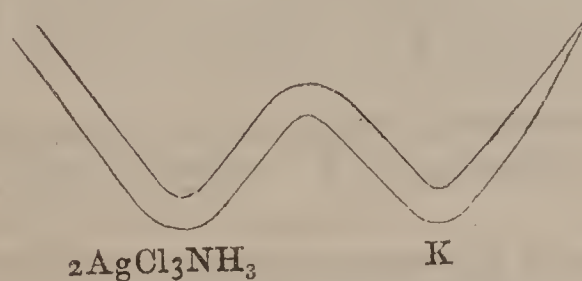
By directing dry ammoniacal gas at a temperature of 212° (100) over this compound it was found possible to remove all the water. At 176° only two equivalents escaped, the removal of the last atom requiring the higher temperature during one to two hours, when it assumed a dark brown colour. The escape of the water was ascertained by the loss of weight of the glass tube containing the substance, and also by the increase in weight of the potash previously saturated with ammonia. On analysis this brown substance proved to consist of one equivalent of nitrogen, four of mercury, and one of oxygen, the latter being estimated as loss.

Like its hydrate, it decomposes by exposure to light and moisture, and evolves ammonia; water converts the hydrate quickly into a white powder, while the anhydrous substance resists longer, and becomes, first of all, converted into the tris hydrate. The anhydrous substance is insoluble in dilute nitric and sulphuric acid, but is easily soluble in hydrochloric acid; but when produced under access of light, it leaves some insoluble subchloride. The tendency of this body to explode increases with its greater dryness, and when anhydrous it requires the greatest possible care in handling; mixed with a large excess of oxide of copper and gradually heated, it may, however, be decomposed without exploding, and its freedom from water proved. This compound has to be considered as oxide of tetramercur-ammonium, and if really possessed of basic properties it must easily show its tendency to combine with electro-negative bodies. The anhydrous salt was first exposed to the action of dry carbonic acid, but without effect; the hydrate, when similarly treated, absorbed the gas, developed heat, and perfect decomposition took place, and carbonate of ammonia sublimed, leaving oxide of mercury. By allowing the carbonic acid to act very gradually, this decom-

position was avoided. For the production of the chloride, hydrochloric acid gas could not be used; but an alcoholic solution of hydrochloric acid gave better results. The brown anhydrate treated in the cold with this alcoholic solution swelled up without altering in colour and appearance, the resulting compound having, however, different chemical properties; it is insoluble in dilute nitric and sulphuric acids; boiled with potash or lime it evolves ammonia, and when analysed it is found to contain chlorine in place of oxygen, so that it must be considered as chlor-tetramercur-ammonium. It exploded also when heated on platina foil, but with less violence than the oxide. At a gradually increased heat 15 to 30 grains could be decomposed in a tolerably wide glass tube without shattering it to pieces; the decomposition was but partial; nitrogen, mercury, and chlorine formed, but the greater portion was left as a yellow heavy substance, similar in appearance to oxide of mercury, but resisting the most powerful reagents. Boiling nitric and sulphuric acids, and potash hardly acted upon it, but hydrochloric acid dissolved it readily. The iodide and nitrate were also prepared by means of alcoholic solutions of hydriodic and nitric acid acting on the anhydrous compounds; they possessed similar but less characteristic properties.

The above results might be taken as furnishing fresh proofs for the ammonium theory, especially when we assume that the hydrogen atoms, which the mercury displaced, occupy an analogous position; but a closer investigation of similar compounds leads to the conviction that the fourth atom of hydrogen occupies a perfectly different position. Many of the ammonium compounds, when heated, part either entirely or to a great extent with their ammonia, and I have strong reasons to believe that chlortetrammonium splits up into NHg_3 and HgCl . Sal ammoniac is formed by the direct combination of ammonia and hydrochloric acid, and according to Pebal separates again at a high temperature into these two compounds—nay, gives off ammonia even at ordinary temperatures. Further, the oxide of ammonium, which must be considered as present in moist ammoniacal gas, may by means of oxygen be easily deprived of its fourth atom of hydrogen, so that all this leads me to the conclusion that metal ammonium has to be considered as consisting of ammonia and hydrogen, and that by substituting an electro-positive metal for the fourth atom of hydrogen, ammonium could be prepared from ammonia.

For this purpose the closed end of a Faraday's tube



was filled with potassium as free from oxide as possible, and the open end filled with chloride of silver saturated with ammonia and the aperture closed by fusion. The end of the tube containing the chloride of silver was now slowly heated to fusion in a chloride of calcium bath. In less than half an hour the potassium commenced to swell, and the portions nearest the silver became covered with small silvery balls, which assumed a darker and darker hue till they fused to a strong metallic copper-coloured mass. In an hour the whole potassium had this appearance—a concave surface, which

* Abridged from *Poggendorff's Annal.*, vol. cxxi., No. iv., page 601.

by flowing along became convex. During the whole operation the chloride of silver had to be maintained in fusion, and the potassium protected against the heat and cooled.

When cold the chloride of silver again absorbs the ammonia, the potassium shrinks, loses its bulk, becomes paler, till it is again as silvery in appearance as before. This reconversion of both bodies requires about a day, but the experiment may be repeated with the same results. On breaking the tube the potassium presents a spongy, porous appearance. It is evident that during these reactions no amid can have been formed, which would have rendered the subsequent reconversion of the two bodies impossible; it must have been, therefore, a simple amalgamation of potassium and ammonium. To ascertain the nature of this amalgam, the following synthetic experiment was tried. First of all it was requisite to ascertain that less than equivalent quantities of ammonium and potassium did not give these reactions, which was the case. According to Rose, two equivalents of chloride of silver absorb three equivalents of ammonia; a Faraday's tube, open on both ends, was therefore filled in an atmosphere of hydrogen, with potassium and sufficient chloride of silver to absorb an equivalent amount of ammonium, which gas was directed through the tube itself, when both ends were closed as before. The experiment when repeated gave perfect results. In this instance one equivalent of ammonium acted on one equivalent of potassium, the compound must therefore have the formula—



potassium occupying the place of the fourth atom of hydrogen.

I reserve for a further investigation whether it is possible to prepare oxides and other salts from this compound, and to ascertain whether the ammonium replaces one atom of potassium in its molecule—



An experiment made with sodium gave similar results; after the reaction and reconversion the sodium had a dull surface instead of the bright silvery appearance of the potassium. To prove the metallic nature of these compounds an amalgam of sodium and mercury was subjected to the same treatment; the pulverulent amalgam became firm, coherent, and appeared as a uniform homogeneous mass with metallic lustre and bronze-like copper colour, it had, however, the same instability, and separated on cooling into ammonia, free mercury, and amalgam.

TECHNICAL CHEMISTRY.

On the Extraction of Potassa from Marl,
by G. J. SCATTERGOOD.*

[WE re-publish this process, thinking it possible that a similar source of alkali might be found available in this country.]

The green sand or marl of New Jersey, according to analysis, contains, among other constituents, from 10 to 12 per cent. of potassa. Query:—"Can this potassa be economically extracted sufficiently pure for pharmaceutical and commercial use, so as to compete in price with that derived from wood ashes?"

The experiments which have been performed in reference to this question require that it should be answered decidedly in the negative. The small proportion of potassa, and the very insoluble form in which it exists in the green sand, are insuperable obstacles to the latter ever becoming a cheap source of commercial potash. The results, however, which have been obtained are not entirely devoid of interest, since they show the effects of certain agents upon a substance whose chemical nature is yet but little known.

The earlier analyses of green sand have shown, as above stated, the large amount of 10 to 12 per cent. of potassa. But later investigations performed by improved methods have not confirmed their accuracy, but, on the contrary, have pointed to the fact that the alkali previously estimated as potassa only is in part soda, and that the average amount of the former throughout the green sand formation in New Jersey does not probably average more than 5 per cent.; and from but few specimens can as much as 7 per cent. be obtained. (Report New Jersey State Geological Survey, 1854.)

The green sand with which the following experiments were tried contained about 6 per cent. of potassa. It is from the second or middle of the three beds into which this deposit in New Jersey has been divided, and was dug on the land of David Marshall, near Blackwoodtown, Camden Co. An analysis performed by the general process for the analysis of soils has given the following result—viz.:—

	(I.)	(II.)
Insoluble silica	5	48
Soluble silica	48	
Protoxide iron	22.74	
Alumina	6.61	
Potassa	5.01	6.84
Soda	1.08	1.47
Lime	1.975	
Magnesia	1.375	1
Phosphoric acid	4.821	
Water	7.50	
	99.611	

The phosphoric acid was estimated as the biphosphate of magnesia. This specimen is in the usual form of small, distinct, green grains, soft enough when freshly dug to be crushed by the nail, but becoming harder on exposure to the air, and exhibiting under the microscope, when washed from adhering clay, a general resemblance in shape to the "casts" of the rhizopods and other minute marine animals. In order to separate the potassa from the green sand, I have tried several of the cheap and powerful chemical agents, carbonic, hydrochloric, and sulphuric acids, quick lime, and sulphate of lime.

Carbonic acid, though a weak acid, has been stated to be one of the readiest agents in decomposing green sand. But I have not been able to obtain by it any appreciable amount of potassa, and only a trace of iron and lime. The quantities used were 100 grains of green sand and 12 ozs. of water charged with carbonic acid.

Hydrochloric acid decomposes green sand, only after being boiled with it for several hours, or after contact with it for several days in the cold. The potassa is thus obtained as a chloride—an undesirable form—and in mixture with other chlorides, the separation from which is attended with considerable expense.

When green sand is treated with sulphuric acid the alumina, as well as the potassa, is dissolved, resulting in the formation of alum. As the quantity thus obtained is considerable, and as this substance has several times already been suggested as a commercial source of alum,

* (Proceedings of the American Pharmaceutical Association.)

I have tried a number of experiments to ascertain the comparative yield. 3500 grains of green sand were treated with 1750 grains sulphuric acid (62 per cent.) diluted with water. The first crop of crystals weighed 630 grains, the second 200 grains, in all 830 grains. The mother liquors still being quite acid, were mixed with 1750 grains more of green sand, and yielded a third crop—306 grains of alum. Again adding a fresh portion of green sand (1750 grains), 100 grains more were obtained, making in all 1236 grains of alum from 1750 grains of sulphuric acid, and 7000 grains of green sand employed. A large quantity of the soft sulphate of the sesquioxide of iron was also obtained, capable of yielding a considerable amount of copperas on being reduced with metallic iron.

When the green sand had been previously roasted, the yield of alum was still greater, the protoxide of iron in the green sand being thus converted into the more insoluble sesquioxide, and thus rendered less capable of combining with the sulphuric acid. 1750 grains sulphuric acid (62 per cent.) treated with successive portions of roasted marl yielded 1686 grains of alum, and an amount of the sulphate of the sesquioxide of iron sufficient to produce 693 grains of copperas.

When the green sand was washed from the adhering clay, which in this case constituted about 9 per cent. of it, the yield of alum was not so great. A greenish crystallo-granular mass, apparently the bihydrated sulphate of the protoxide of iron, not observed in the preceding cases, was also obtained. 1750 grains sulphuric acid (62 per cent.) treated with successive portions of washed green sand produced 785 grains alum and 626 grains copperas.

It thus appears that, with a cheap source of sulphuric acid, the manufacture of alum from the green sand of New Jersey might, perhaps, be profitably carried on. And it may possibly hereafter be found that, within the limits of this formation itself in New Jersey, the material for furnishing a cheap supply of the acid exists, in the sulphuret of iron which is widely disseminated throughout certain sections of it, or in those compounds of iron, or of alumina and iron with sulphuric acid, which give those properties so injurious to vegetation to the so-called "poison," or "burning marls."

The state of combination in which the ingredients of green sand exist in it has been considered to be that of silicates. Pelouse has called attention to the power which sulphate of lime has in decomposing glass, a mixture of various silicates. With a view to ascertain whether sulphate of lime would have any effect in removing potassa from the green sand, 50 grains of it, 100 of green sand, and 4 ozs. of water were mixed together, and allowed to remain in contact two or three days. Upon evaporating the liquid to dryness, 6.31 gr. of solid matter were obtained, which contained only .06 gr. of potassa, about $\frac{1}{100}$ th of the amount existing in the quantity used, the remainder being principally sulphate of lime.

When green sand is treated with quicklime and water a very small amount of potassa is obtained. 100 grains quicklime, 100 grains green sand, and 4 ounces water were mixed together, and after standing in contact for seventy-two hours, the liquid was evaporated to dryness. The solid matter obtained, weighing $5\frac{3}{4}$ grains, contained but .04 grains of potassa; alumina, protoxide of iron, and carbonate of lime constituting the remainder.

The form of combination in which the silica, the iron, and the other ingredients exist in the green sand has not been fully determined. This substance has been

regarded as essentially a protosilicate of iron. But I have noticed that upon treating the grains with acid, without powdering them, after the green portion of them is entirely dissolved, the silica is left behind in the form of small white grains of the same shape as the original grains, and not in that state of fine division in which it would be if it had just been liberated from a state of combination. These grains of silica, after ignition, are readily soluble in a cold solution of potassa, from which facts it is inferred that the silica has not been combined with iron, &c., as a silicate; and that the green sand should not be considered as a mixture of various silicates. Whether the ingredients are in a state of combination at all, or merely in intimate mixture, remains unascertained.

It would appear that during that remarkable change which has resulted in the formation of these "casts" of minute marine animals, which the researches of Ehrenberg and the late Professor Bailey have shown these green grains to be, the silica has been deposited in the cavity of the shell upon or during the decay of the animal; while the green-coloured matter, consisting of iron, alumina, potassa, &c., has been gradually deposited in the shell around it by a kind of petrefactive process during the removal of its carbonate of lime.

PHARMACY, TOXICOLOGY, &c.

On Veratria from Veratrum Viride,
by S. R. PERCY, M.D.*

ANY quantity of the coarsely-powdered root of the *veratrum viride* is moistened with water and packed into a percolator; water acidulated with hydrochloric acid, sufficient to cover the root, and allowed to stand for twenty-four hours.

It is then allowed to percolate, and the first portion of the fluid, which contains most of the strength of the root, is kept by itself; fresh acidulated water is added, until the root is exhausted.

The latter liquid is evaporated to about one quarter of its former bulk, filtered, and the first portion of the percolate mixed with it; soda is then added so long as a precipitate forms. The precipitate is washed in a small quantity of cold water and dried: it is then treated with ether; the ether is filtrated off, and allowed to evaporate.

This mass is then treated with water acidulated with hydrochloric acid, filtered, and ammonia added so long as a precipitate forms; the fluid is filtered off; the precipitate washed in a small quantity of cold water, and mixed with a small amount of animal charcoal which has been previously moistened with a little alcohol.

The whole is put into a flask, and alcohol added to it; the flask is put in hot water, and the hot alcoholic solution filtered off and more alcohol added, which is treated in the same way.

The whole of the alcoholic solution is either distilled or evaporated, according to the quantity of alcohol used; and the soft mass that is left is treated with successive quantities of boiling water, acidulated with hydrochloric acid. This solution is filtered, and the alkaloid is precipitated with ammonia.

The precipitate, when dry, is treated with ether, filtered, and the ether allowed to evaporate slowly.

The alkaloid is in a semi-crystalline state of a slightly yellow tinge.

To prevent the excessive and painful sneezing caused

* Extracted from a Prize Essay on "The Physiological and Medicinal Properties of *Veratrum Viride*."

by inhaling this alkaloid, I have found it advisable, when manipulating with it, to anoint the nostrils as far up as possible with castor oil, and to tie over the nostrils a piece of moistened sponge.

As thus obtained, veratria from *veratrum viride* is, if precipitated, a pure white amorphous powder; if from the evaporation of ether, it is semi-crystalline and of a slightly yellow tinge.

It is of an acrid and burning taste, but is not very bitter. It is necessary to be extremely cautious in handling it, for if a very minute portion is breathed up the nostrils it excites violent sneezing, which is difficult to check, and occasionally produces alarming symptoms.

Its formula is probably the same as that of commercial veratria. $C_{34}H_{22}NO_6$ ve.

If a small quantity of veratria be placed upon platina and held over a flame, it fuses at a gentle heat; if it be now removed, it solidifies as it cools, and becomes a semi-transparent yellow mass; but if the heat be continued it swells up, and is gradually dissipated. It is insoluble in water, but readily soluble in ether, alcohol, chloroform, and benzole.

It neutralises acids, and forms salts which are soluble in water; they are of an acrid and persistently burning taste, and produce a considerable degree of irritation if rubbed upon the skin.

For the purpose of experimenting, a given quantity of the alkaloid was dissolved in a given quantity of distilled water, with precisely sufficient hydrochloric acid to effect its solution.

1. *Potassa*.—Potassa produces in solution of hydrochlorate of veratria a copious, flocculent, dirty-white precipitate, which is not soluble in an excess of the reagent. If viewed immediately on precipitation by a low power of the microscope, it is seen in coagula; but if viewed after standing some minutes many short prismatic crystals will be seen amongst the coagula, which shortly disappear. The $\frac{1}{100}$ th grain of this veratria is most readily detected by this reagent, and with the microscope $\frac{1}{1000}$ th may be easily recognised. The carbonate of the alkalies acts in the same manner as potassa.

2. *Ammonia*.—The reaction is the same as with potassa, but the precipitate is slightly soluble in an excess.

3. *Nitric Acid*.—If concentrated nitric acid is brought into contact with this alkaloid it agglutinates into resinous-looking lumps of a dirty-yellow colour, which slowly dissolve in the acid. If the alkaloid is first moistened with water and a small quantity of nitric acid then applied, it exhibits a yellow tint, but on the addition of water forms a colourless solution.

4. *Sulphocyanide of Potassium*.—A flocculent white precipitate insoluble in excess of the reagent.

5. *Chromate of Potassa*.—A light yellow amorphous precipitate, insoluble in an excess.

6. *Bichromate of Potassa*.—A copious dirty-yellow, amorphous precipitate, insoluble in an excess of the reagent, but soluble in nitric acid.

7. *Ferricyanide of Potassium*.—A copious bluish-black, flocculent precipitate, soluble if a small excess of the reagent is carefully added.

8. *Ferrocyanide of Potassium*.—An abundant greenish-yellow precipitate, soluble in an excess.

9. *Iodide of Potassium*.—A dirty-white amorphous precipitate, becoming a dirty-greenish-white upon standing some time.

10. *Iodine in Iodide of Potassium*.—A copious reddish-brown, amorphous precipitate, soluble in liquor potassæ.

11. *Bromine in Bromohydric Acid*.—A dull yellow amorphous precipitate.

12. *Carbayotic Acid*.—A greenish amorphous precipitate, which, upon standing a short time, becomes a greenish-yellow.

13. *Bichloride of Platinum*.—A dirty yellow amorphous precipitate.

14. *Bichloride of Mercury*.—A white precipitate.

15. *Tannic Acid*.—A dirty white amorphous precipitate.

16. *Terchloride of Gold*.—A canary yellow amorphous precipitate, insoluble in an excess of the reagent, and insoluble in acetic acid, except upon the application of heat.

17. *Sulphuric Acid*.—This test should always be applied to the alkaloid or its salts in a dry state. If a small portion of the alkaloid is touched with a drop of strong sulphuric acid no colour is immediately developed, but in the course of a minute a yellowish-red, and then a beautiful bright red colour appears. This colour will appear immediately upon touching the veratria with the sulphuric acid if the slide upon which it is placed is warmed. The colour is not destroyed by heat, but it disappears after standing two or three hours; the colour will disappear in fifteen minutes if a small crystal of bichromate of potash is stirred upon the mixture.

Professor Wormly has by this reagent detected $\frac{1}{50000}$ th of a grain of purified commercial veratria.

This last reagent—sulphuric acid—is the only one of all these that can be deemed decisively confirmatory of the presence of veratria; the other reagents are common to so many organic substances that they can only be regarded as confirmatory in connexion with the action of sulphuric acid.

There is but one substance with which it would be at all likely to be confounded by this reaction of sulphuric acid, and that substance is salicine. Sulphuric acid produces a red colour on solanine, narceine, papaverine, and piperine, but, as with salicine, the colour is produced immediately upon the contact of the cold acid.

But the reaction of sulphuric acid upon salicine and veratria differs, for whereas on salicine the colour is immediately produced upon the application of sulphuric acid on a cold slide, we have seen that the colour does not appear for a minute or more with veratria unless the slide or the acid is warmed.

The colour produced is also different, for with veratria it is, for a moment, a yellowish and then a beautiful bright red, then an intense blood red colour; with salicine it is more of a purple red. There is the difference between the two colours that there is between bright arterial and venous blood. The colour produced upon veratria lasts but two or three hours, while that produced upon salicine lasts double that time.

But the behaviour with other reagents would definitely settle the point if doubts were excited.

In a correspondence with Geo. J. Scattergood, of Philadelphia, on this subject, he says:—

“By treating commercial veratria with ether, I have separated it into two substances. That portion insoluble in ether behaves with sol. of iodo-hydrarg. potass., and with tr. iodine, on a muriate boiling, and sal amn onia added while yet warm, differently from the way pure veratria does. Veratria, soluble in ether, gives a beautiful pink, red, or crimson colour with sulphuric acid, and butyric acid smell; the matter insoluble in ether gives a darker colour, a greenish or brownish red, and a musky odour.”

It will thus be seen that in following the experiments

of Professor Wormly with veratria obtained from veratrum sabadilla, we have obtained almost identical results with the veratria we have made from veratrum viride, and have thus confirmed Mr. Richardson's observations, that the two alkaloids were identical in their chemical reactions.

PROCEEDINGS OF SOCIETIES.

LECTURES ON CHEMICAL PHILOSOPHY.—IV.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 81.)

Compound Radicals.

A celebrated chemist has said that "organic chemistry is the chemistry of compound radicals," wishing to indicate thereby that compound radicals play in organic chemistry the same part that elements play in mineral chemistry. We now know that this is not correct, and that compound radicals belong as much to mineral as to organic compounds. It is not less true, however, that the theory of organic radicals has exercised an important influence on the progress of the science, and particularly of organic chemistry.

Let us, therefore, trace the history of the question so as to see the connexion between the new and the old ideas.

The idea of *radicals* dates from Lavoisier. He supposed that ternary organic compounds of carbon, hydrogen, and oxygen might be regarded as oxides of binary radicals with two bases; that the quaternary compounds of carbon, hydrogen, oxygen, and nitrogen might be oxides of radicals with three bases. The radicals of Lavoisier, however, were hypothetical. The great master was restricted to this qualitative indication of their nature, for their true composition was not known in his time, and not one of them had been isolated.

The first discovery which gave some consistence to the idea of radicals was that of cyanogen by Gay Lussac in 1814. Cyanogen is composed of an atom of nitrogen, N, and an atom of carbon, C,* or of one equivalent of nitrogen, N, and two equivalents of carbon, C₂ (CN = C₂N). Cyanogen exists in the free state; it combines directly with simple bodies to form compounds resembling the binary compounds of chlorine, bromine, &c.; in a word, it plays a part exactly analogous to that of an element. These are the distinctive characteristics of a true radical.

This discovery had a very important influence on the later developments of chemistry.

In 1828, Dumas and Boullay demonstrated that olefiant gas, or etherine, might also be considered as a sort of radical capable of entering directly into combination with the elements of water to form alcohols and ethers. Olefiant gas (represented in equivalents) being C₄H₄, we have according to them the following series:—

Olefiant gas	C ₄ H ₄
Ether	C ₄ H ₄ ,HO
Alcohol	C ₄ H ₄ ,2HO
Hydrochloric ether . .	C ₄ H ₄ ,HCl
Acetic ether	C ₄ H ₄ ,C ₄ H ₃ O ₃ ,HO

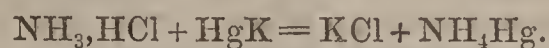
Dumas and Boullay compared this series with the ammoniacal series having for radical NH₃, which they formulated thus:—

Hydrate of ammonia . .	NH ₃ ,HO
Binhydrate of ammonia .	NH ₃ ,2HO
Hydrochlorate of ammonia	NH ₃ ,HCl
Acetate of ammonia . .	NH ₃ ,C ₄ H ₃ O ₃ ,HO

The two series are perfectly similar and, to say the truth, parallel. But, independently of this theory of the constitution of ammonical salts, there exists another which is founded upon the existence of the curious compound

which is known as ammonium amalgam. We know that this may be formed either by electricity or in the moist way. In the hands of Ampère and Berzelius, this discovery became the source of a new interpretation of the facts relating to ammonia.

The amalgam of ammonium is formed according to the equation



In the body NH₄Hg we may admit the existence of the group NH₄. This group has never been isolated; but as it enters into combination with mercury without destroying its metallic lustre, we are to some extent justified in comparing it to a metal. And if we admit the existence of such a group as NH₄ in the ammoniacal compounds, these become comparable to the compounds of a metal—potassium, for example:—

(NH ₄)O	KO
(NH ₄)O,HO	KO,HO
(NH ₄)Cl	KCl
(NH ₄)O,C ₄ H ₃ O ₃	KO,C ₄ H ₃ O ₃ .

This analogy between the ammonical salts and the salts of potassium is supported by a number of facts, among which it is only necessary to notice the isomorphism of the chlorides and the chloroplatinates.

M. Chevreul has raised an important objection to the ammonium theory. We can admit, he says, the existence of the ammonium group NH₄, and that the hydrochlorate NH₃HCl is a chloride NH₄Cl; but how can we suppose that hydrochloric acid, a very stable compound of two elements having a strong reciprocal affinity, can part with its hydrogen to give rise to the group NH₄, so unstable that it cannot exist in a free state?

This objection is well founded, and would be unanswerable, if we wished to regard chloride of ammonium as containing ammonium on the one side and chlorine on the other. But we must remember that in chemical combinations all the atoms exert an action one upon another. In hydrochlorate of ammonia, the affinity which resides in the chlorine is satisfied not by such and such atom of hydrogen, but in some way by the resultant of all the affinities which reside in the other elements; and we can imagine that the nitrogen on its part also contributes to establish the molecular equilibrium. When HCl combines with NH₃ we cannot assert that the hydrogen remains combined with the chlorine. All we know is that the result of the combination contains six atoms, whose affinities respectively saturate each other.

The idea of ammonium became the starting point of a new theory of alcohols and ethers. Berzelius supposed in these compounds the existence of a radical C₄H₅, which he named *ethyle*. This radical is exactly comparable to potassium; it behaves like a simple body, and may be transported entire from one compound to another. We can, in fact, establish a complete parallel between the compounds of ethyle and those of potassium.

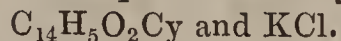
(C ₄ H ₅)O, ether, oxide of ethyl.	KO, oxide of potassium.
(C ₄ H ₅)O,HO, alcohol, hydrate of oxide of ethyle.	KO,HO, hydrate of oxide of potassium.
(C ₄ H ₅)Cl, chloride of ethyle.	KCl, chloride of potassium.
(C ₄ H ₅)O,C ₄ H ₃ O ₃ , acetate of ethyle.	KO,C ₄ H ₃ O ₃ , acetate of potassium.
(C ₄ H ₅)O,HO; S ₂ O ₆ , sulphovinic acid or acid sulphate of ethyle.	KO,HO,S ₂ O ₆ , acid sulphate of potassium.

Unfortunately, this radical, C₄H₅, cannot be isolated; it only exists in a state of combination, and when set at liberty its molecule divides.

We must say the same of benzoyle, introduced into organic chemistry by Liebig and Wöhler about 1828. By passing chlorine into the essential oil of bitter almonds, C₁₄H₆O₂, they obtained the compound C₁₄H₅O₂Cl,

* We shall follow the Lecturer by indicating the double atom by means of *italic* capitals.

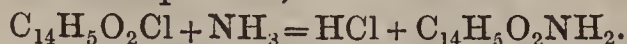
which they called chloride of benzoyle. By heating this chloride with cyanide of potassium they formed



By acting on the chloride with sulphide of lead they also formed a sulphide, $C_{14}H_5O_2S$, by double decomposition,—



Under the influence of NH_3 the chloride of benzoyle undergoes another metamorphosis. This also is effected by a double decomposition, and we have—



This last compound is amidide of benzoyle or benzamide. These various reactions show us a ternary group behaving like an element, in so far as it lends itself to double decompositions and passes entire from one compound to another. But, we must repeat, this group has never been isolated.

This conception of radicals, however, differs from that of Dumas and Boullay. It marks a new phase in the development of the theory. Berzelius at first received it with enthusiasm, then he rejected it. Faithful to his dualistic notions, he imagined that benzoic acid was the hydrate of a tritoxide, $(C_{14}H_5)O_3 + HO$, comparable to acetic acid, $(C_4H_3)O_3 + HO$. To him the radicals were hydrocarbides, which united with oxygen in the same way as metals. Liebig and Wöhler, on the contrary, represented these two acids, the former by $[(C_{14}H_5O_2)O, HO]$, and the latter by $[(C_4H_3O_2)O, HO]$.

The formulæ of Berzelius are hypothetical; those of Liebig and Wöhler are supported by experiment; they represent reactions.

The discovery of *cacodyle* by Bunsen gave a fresh impulse to the theory of radicals. *Cacodyle* is the name Bunsen gave to the radical of the fuming liquor first obtained by Cadet about 1750 by the distillation of arsenious acid and acetate of potash. Bunsen isolated this *cacodyle* $As(C_2H_3)_2$, and found that it possessed all the properties of a radical; that it combined with oxygen to form an oxide, the fuming liquor of Cadet, an acid $[As(C_2H_3)_2O_3]$ comparable to SO_3 .

Cacodyle realises as completely as cyanogen the idea of a compound radical. Not only does it pass intact from one combination to another, not only does it lend itself to double decompositions, but it possesses the more important attributes of a simple body, it can be isolated and enter into direct combination with other bodies. The great objection which had been brought against the theory of radicals was thus upset; all radicals are not creatures of the imagination, for cyanogen and *cacodyle* can alone exist. To isolate the others became the work of the future.

Gerhardt was far from thinking so. He rejected the idea of considering cyanogen, *cacodyle*, and benzoyle as radicals, and tried to explain the metamorphoses in which these groups participated in another way. On this account he undertook those experiments which led him to the adoption of his memorable theory.

As far as regards the benzoic compounds, he arrived at the conclusion that chloride of benzoyle is no other than the hydride of benzoyle, in which the hydrogen is replaced by chlorine, and not the chloride of a radical. The hydride is C_7H_5O , and the chloride $C_7(H_5Cl)O$.† If we act on this chloride by ammonia, we have, according to Gerhardt, the following metamorphosis:—



There is a double decomposition, the formation of HCl and the production of two residues— NH_2 and C_7H_5O —which combine at once to produce the compound $C_7(H_5, NH_2)O$, or benzamide.

The reaction of water upon chloride of benzoyle is analogous:

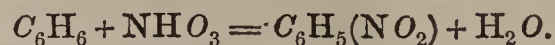


Here there is again a double decomposition, which is

† The lecturer here returns to the new notation.

ended by the combination of two *residua*— HO and C_7H_5O .

So in the formation of nitrobenzine:

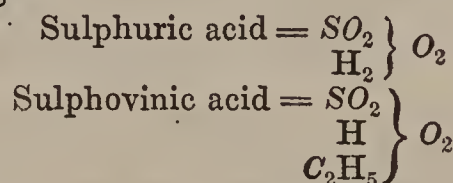


Again, in the formation of sulphovinic acid:



Gerhardt admitted that these *residua* which enter into combination often unite in a peculiar way, and that the products which they engender present odd properties. Thus sulphuric acid precipitates baryta, while sulphovinic acid does not; chloride of potassium precipitates salts of silver, but chloride of ethyle does not. The illustrious chemist explained this by supposing a special mode of combination, which he called *copulation*. Sulphovinic acid and chloride of ethyle, he said, were *copulated* or *conjugated* compounds.

This idea was the source of much discussion, the influence of which, it must be confessed, has been but small. There is no occasion, in fact, to have recourse to the idea of copulation to assign a reason for the facts relating to sulphovinic acid and chloride of ethyle. If the former does not precipitate baryta it is because sulphuric acid exists no longer.

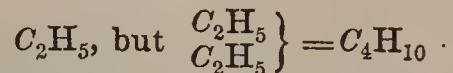


In $SO_2 \left. \vphantom{\begin{array}{l} SO_2 \\ SO_2 \end{array}} \right\} O_2$ the H_2 are replaceable immediately in the cold by Ba . This substitution is no longer possible in the cold when H is replaced by C_2H_5 . But everybody knows that it is only necessary to heat sulphovinic acid to the boiling point to regenerate the sulphuric acid.

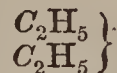
If chloride of ethyle does not precipitate nitrate of silver it is partly from the circumstance that it is an insoluble gas. If, in place of chloride of ethyle, we take the iodide, and replace the aqueous solution of nitrate of silver by an alcoholic solution with which the iodide can mix, then the precipitation takes place.

The idea of Gerhardt, then, respecting copulation is sterile, and may be forgotten; but his conception of residues has been productive, and will remain. He has shown, in fact, that these residues are incomplete molecules, *débris* of molecules, which can play the parts of simple bodies,—that is to say, enter into a body or go out of it intact—be substituted for simple bodies, &c. The residues are to him, indeed, only radicals; but instead of considering them as bodies able to exist free and alone, he maintains that they are bodies in which the molecular equilibrium is broken, and consequently they are unable to exist by themselves.

Frankland, however, in 1849, succeeded in separating ethyl from the iodide. Gerhardt immediately examined the new gas (for it is a gas), and he maintained that free ethyle is not



that is to say, it is a double molecule. He supported his view by the fact that Frankland's ethyl is incapable of giving rise to ethylic compounds—which proves incidentally that the affinity which binds together the two ethylic groups in



is much stronger than that which binds together the two atoms of hydrogen. Thus so far as ethyle is concerned his theory is safe. C_2H_5 does not exist in the free state.

But there are bodies which play the part of compound radicals, and possess all the attributes of a radical. Without mentioning cyanogen and *cacodyle*, we may rank among the number of radicals sulphurous acid gas, and

carbonic oxide. These bodies can enter into direct combination either with chlorine or with oxygen.

$SO_2.Cl_2$ chloride of sulphuryle.
 $SO_2.O$ sulphuric acid.
 $CO.Cl_2$ chloride of carbonyle.
 $CO.O$ carbonic acid.

The idea of compound radicals then is real. Some are residues which only exist in combination, but which can pass from one compound to another. Others can exist in the free state, and enter directly into combination; but these also are residues and only function as radicals because they constitute incomplete molecules. We shall pursue this idea further hereafter.

ACADEMY OF SCIENCES.

August 8.

MM. DAMOUR and H. Deville contributed a new analysis of the rare mineral *Parisite*. This mineral is composed of a mixture of the carbonates and fluorides of cerium, didymium, lanthanum, and lime. A detailed account of the analysis is given, which we shall soon extract at some length, since it contains a new method of separating the above-named metals.

M. St. Edme gave an account of "*Some Experiments relating to Electrolysed Oxygen*." The following are the principal facts mentioned:—The oxygen obtained when water but *slightly* acidulated is decomposed has no effect on Schonbein's paper, neither has the oxygen from the strongest hydrated sulphuric acid ($SO_3)_2.HO$. In the latter case the acid is decomposed, for sulphur appears at the negative pole. On the contrary, when the ordinary acid of the laboratory is employed, the oxygen strongly affects the papers.

Fused chromic acid decomposed by the battery gives oxygen which does not affect the test paper, which is also the case when a dilute solution of the acid is electrolysed; but when a saturated solution is decomposed, active oxygen is obtained. The oxygen evolved when chromic acid is decomposed by heat is also active.

The oxygen obtained when glacial phosphoric acid slightly moistened is decomposed, acts on the papers; that from a weak or even a strong solution of the acid will not act.

Moistened potash and soda yield active oxygen, while concentrated solutions of them do not. These facts, the author says, seem to indicate that the oxygen obtained by electrolysis from a binary compound is not ozonised. The ozonised state is only manifested when the decomposing action of electricity has to overcome a double chemical affinity, which, in the preceding cases, were—1. The mutual affinity of the oxygen and hydrogen; and 2, that of the water for the acid or the base. The author infers, therefore, that the property of ozone is only a difference in the dynamic condition of oxygen, and not a chemical or physical transformation.

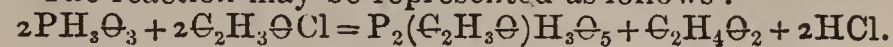
M. Salvétat presented a note "*On the Estimation of Oxide of Cobalt*." After separating the oxide by the known methods, the author recommends that, instead of reducing it in a current of hydrogen, it should be calcined with a known weight of alumina, or better, of a salt of alumina, which, after the calcination, leaves a known proportion of residue. The increase of weight will represent the cobalt in the state of protoxide.

M. Friedel communicated a "*New Process for the Preparation of Allylene*." The author has found that chlorated propylene, C_3H_5Cl , which is easily obtained by the action of perchloride of phosphorus on acetone, answers well for the preparation of allylene. He heats it in a sealed tube with an excess of ethylate of soda. After eighteen hours' exposure at 120° , a large quantity of allylene escapes on opening the tube.

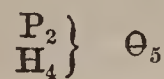
M. Menshutkin contributed a memoir "*On the Action of*

Chloride of Acetylene on Phosphorous Acid." The author first notices a remarkable difference between the neutral salts and ethers of phosphorous acid. In the neutral salts the metals only replace two atoms of hydrogen; in the neutral ethers the alcoholic radicals replace the three atoms of hydrogen of the phosphorous acid. It is the same with several organic acids. The study of lactic and other analogous acids has led to the notion of a hydrogen which has been named *alcoholic*, which cannot be replaced by metals, but may be by alcoholic radicals or acids. With the view of obtaining the acid $P(C_2H_3O)H_2O_3$ which should exist if phosphorous acid contained alcoholic hydrogen, the author investigated the reaction of chloride of acetylene on phosphorous acid. The reaction, however, was different. One equivalent of each body was heated to 120° in a sealed tube for fifty hours. The tube being opened two or three times allowed large quantities of hydrochloric acid to escape. When the reaction was finished a white crystalline mass was left, which was dried in a current of carbonic acid gas to get rid of hydrochloric and acetic acids. The mass dissolved in water, forming a strongly acid solution, which on saturation with potash and evaporation yielded large oblique, rhomboidal prisms of a salt of a new acid the author proposes to call *acetopyrophosphorous acid*, the composition of which is— $P_2(C_2H_3O)H_3O_5 + 2H_2O$.

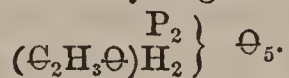
The reaction may be represented as follows:—



As regards the constitution, the author considers it pyrophosphorous acid—



in which one atom of hydrogen is replaced by acetylene—



A paper "*On the Separation of Titanic Acid and Zircon*," by M. Pisani, is a valuable contribution to analytical chemistry, which we shall give at length in an early number.

MM. E. Millon and Commaille gave an account of "*A New Albumenoid Substance in Milk*." They separated casein from cow's milk by means of acetic acid, filtered the liquor, then heated it, and obtained a new coagulum which they found to possess the external characters of albumen, and also to contain the same amount of nitrogen. They call the substance provisionally *lactoproteine*. There appears to be but a small quantity of this substance present in milk, but it may be precipitated by the careful addition of acid nitrate of mercury.

NOTICES OF BOOKS.

Zeitschrift für Analytische Chemie. Edited by Dr. R. C. FRESENIUS. Heft I. 1864.

THIS number of one of the most useful of chemical journals contains several papers of considerable interest, to which we shall have to return, so we shall give now only the titles. The first, by Werther, *On the Estimation of Thallium*, we have noticed before in the *Journal für prakt. Chemie*. The next paper is Dr. Mohr, *On the Estimation of Carbonic Acid*, for which purpose he makes use of baryta water. A process is also given for estimating in mineral waters in one operation the free, the combined, and the half-combined carbonic acid by means of baryta water and chloride of barium. As this paper has some practical interest we shall abstract it. *Researches on the Chemical Composition of Wood-Gas* is a valuable contribution to our knowledge of the condensable products in this gas. In a note *On the Appearance of Fluoric Acid in Elementary Analysis*, Kraut mentions that he has sometimes found fluoric acid in the chloride of calcium tube derived from the asbestos plug made use of. A paper *On the Quantitative Estimation of Cyanogen in Bitter Almond*

Water, by S. Feldhaus, will have much interest to Continental pharmacutists and physicians, but owing to the limited use of the article in this country is of small importance to us. The most interesting paper in the number is one *On the Sublimation of the Alkaloids, &c.*, by Dr. Helwig, in which the author shows that morphia, strychnia, brucia, veratria, aconitia, atropia, solanin, and digitalin may be sublimed, and the microscopic appearance of the sublimate serve for the recognition and identification of these alkaloids. To this and another paper by the same author *On the Use of the Microscope in Toxicology* we shall shortly return. The only other paper we need notice now is a *Contribution on the Method of Estimating Ammonia and Nitric Acid by a Bromated Solution of Hypochlorite of Soda*, by Krockner and Dietrich.

A Class Book of Rudimentary Chemistry. By the Rev. GEORGE POPE, M.A., &c., &c. London: Stanford. 1864.

THIS is a very small book, intended for the use of the compiler's own classes at Hurstpierpoint College, preparatory to their using the text-book in Chambers' Educational Course. "Definitions and statements have, therefore," says the compiler, "been put in the briefest and most dogmatic form . . . and strict scientific accuracy has consequently been sometimes sacrificed."

The book is an attempt at simplifying the elements of chemistry. We have some doubts whether the author has succeeded in making matters clearer upon all occasions, but the attempt is to be commended, and the book will be found useful in schools.

NOTICES OF PATENTS.

2551. *Separating Sugar from Molasses, &c.* FÉDOR DE WYLDÉ, Trinity Square, Tower-Hill. A communication from Dr. Henry Schwartz, of Breslau, in Prussia. Dated October 17, 1863.

THESE improvements refer to a process of separating molasses and other impurities from sugar crystals, and are also applicable to the refinement of the concentrated and crystallised juice of the sugar-cane, beet-root, or other sacchariferous plants. The invention is thus described by the patentee:—

"I take raw sugar from sugar-cane, beet-root, or other sacchariferous plants, and ascertain (by combustion and subsequent saturation of the ashes with an acid) the quantity of organic salts of lime and alkali which are contained therein. For every part of ashes obtained I reckon ten parts of molasses are present in the raw sugar. Having thus ascertained the quantity of acid necessary for saturating the ashes, I add the same proportion to decompose the molasses in the raw sugar with the inorganic acids and salts of the alkalies. Any acids may be used which form with the lime or alkali salts which are soluble in alcohol, methylated, or wood spirits. By preference, I take muriatic or acetic acid. A mixture of alcohol, or methylated spirit, with a due proportion of water and the necessary acid, will dissolve all the molasses, and leave behind crystals of sugar perfectly white and free from all impurities."

Having broken up the raw sugar in a suitable mill, the inventor proceeds to mix with it the spirit and acid according to the following directions:—"The spirit should be used of such strength as to contain about 80 per cent. of absolute alcohol. A raw sugar which leaves on burning 1 per cent. of ashes, and consequently contains 10 per cent. of molasses, demands $1\frac{1}{2}$ per cent. of muriatic acid of commerce, and 24 per cent. of the alcohol or methylated spirit already specified, but stronger or weaker solutions may be used according to circumstances. In this menstruum the molasses only are dissolved, the crystals of

pure sugar being insoluble or very slightly soluble therein.

"I now separate the acid solution of the molasses from the sugar crystals by filtration, or by a centrifugal machine with suitable perforations worked at a moderate speed. The liquid which still adheres to the crystals may be removed by treating them with neutral alcohol or methylated or wood spirit, which may be caused to pass through the crystals very rapidly in the same rotatory vessel. The alcohol or methylated spirit should be increased in strength as this operation proceeds, until at last absolute alcohol or methylated spirit should be used as the final menstruum. The crystals so produced should be dried in a current of hot air. During the process I collect the alcohol by passing the atmospheric air charged with the volatilised spirit through or over water by any suitable arrangement. The neutral alcohol or methylated spirit by a proper system of working may be used several times, and when too highly charged with impurities can be used for mixing with the acid and water for the primary operation. The spirituous solution of molasses can also be distilled (after the addition of lime to neutralise it) and thus the alcohol may be regained without loss. By adding an excess of lime to the alcoholic solution of molasses a precipitate is formed consisting of sugar and lime, which on decomposition by carbonic acid will yield a solution of sugar, and thus a further per centage is gained from the molasses."

The invention above described is stated to have been made the subject of a patent claim likewise in France; and since the date of the foreign specification the principle upon which it is based has received the sanction of M. Dumas, who proposes to employ a mixture of acetic acid and alcohol in the valuation of sugar samples upon which a duty has to be levied. In the treatment of an inferior description of raw sugar known as "Mauritius brown," we found no difficulty, by working this process on a small scale, in obtaining upwards of 90 per cent. of sugar crystals of a very pale brown colour, besides the molasses liquor, which could afterwards be fermented and distilled, or otherwise worked to advantage. By operating upon a superior quality of brown sugar we obtained perfectly white crystals. The excise regulations of this country must be a bar to the employment of pure alcohol, which appears to give much more satisfactory results than the cheaper wood naphtha or methylated spirit; the use of either of the latter imparts an objectionable odour and flavour to the product, which cannot be got rid of even by drying the sugar in a current of warm air. In our own trials it seemed preferable to maintain the ordinary atmospheric temperature throughout the process of refining, the moist sugar crystals being so easily liquified by the application of even a moderate heat. We presume the expression "absolute alcohol" made use of in the latter part of the specification is not intended to bear the strict meaning which chemists would attach to it, but refers to an ordinary quality of alcohol or methylated spirit which for this purpose is not required to be mixed with additional water or employed conjointly with acid. But for our system of duties this would be a valuable process, and even now might no doubt be used with advantage in the colonies.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1780. Israel Swindells, Wigan, Lancashire, "Improvements in obtaining hydraulic and other cements from residuums or wastes."—Petition recorded July 15, 1864.

1784. Amélie Angelina Bonnet, Rue de la Fidélité, Paris, France, "Certain improvements in the mode of preparing and applying chemical fumigations to the treatment of human diseases, and in apparatus connected therewith."

1786. John Clayton, West Bromwich, Staffordshire,

"Improvements in furnaces for heating and melting iron and steel, and for other purposes."

1789. Andrew Barclay, Kilmarnock, Ayrshire, N.B., "Improvements in the manufacture of pig iron and in the machinery or apparatus employed therein."—Petitions recorded July 16, 1864.

1799. Antoine Espirat and Etienne Sauce, Marseilles, France, "An improved filter."

1804. Henry Edward Francis De Brion, Welbeck Street, Cavendish Square, Middlesex, "An improved composition for protecting and preserving metals, such as iron, copper, and zinc, used in the construction of ships or in the protection of their sides and bottoms from oxidation and corrosion from the action of the sea water, and for protecting from corrosion all submerged substances, such as chains, anchors, cables, and every oxidable metal submerged in water or exposed to atmospheric influences."—Petitions recorded July 19, 1864.

1814. Alfred Barton, Joseph Sidebotham, and Thomas Henry Nevill, Strines, Derbyshire, "Improvements in the treatment of printed or dyed calicoes and other fabrics."—Petition recorded July 20, 1864.

1815. Edward Young, Oughtibridge, near Sheffield, Yorkshire, "Improvements in drying and calcining iron and other ores."

1821. John Whitford, Liverpool, Lancashire, "Improvements in machinery or apparatus for agitating freezing mixtures, for cooling wine and other liquors or liquids, and for manufacturing ice and ice cream."

1823. Alfred Vincent Newton, Chancery-lane, Middlesex, "Improvements in electro-telegraphic apparatus."—A communication from Royal House, New York, U.S.A.—Petitions recorded July 21, 1864.

1827. William Edward Gedge, Wellington-street, Strand, Middlesex, "An improved process or means of decongelating oils."—A communication from Eugène Bernard and Eugène Perrin, Faubourg St. Martin, Paris, France."

1828. Johannes Möller, Shaftesbury Villas, Hornsey Rise, Middlesex, "Improvements in the manufacture of marking ink."—Petition recorded July 22, 1864.

1833. Dennis Hall, Winsford, Cheshire, and August Ludwig Roosen, Manchester, Lancashire, "Improvements in the manufacture of salt."

1842. David Barker, Battersea Park, Surrey, "Improvements in the manufacture of artificial fuel."—Petitions recorded July 23, 1864.

1870. John Olive, William Olive, and Edward Partington, Woolfold, near Bury, Lancashire, "Improvements in the manufacture of paper, and in the machinery and apparatus employed therein."

1876. Jean Pierre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of steel."—Petitions recorded July 27, 1864.

1506. Peter Spence, Smedley New Road, near Manchester, and Henry Davis Pochin, Broughton Old Hall, near Manchester, "An improvement in smelting copper ore."—Petition recorded June 17, 1864.

1706. Thomas Sharp, Nashville, Tennessee, N.A., "Certain improvements in tanning hides, and in the apparatus employed therein."—Petition recorded June 17, 1864.

1875. Jeanne Pierre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in preventing the oxidation of iron and steel."—Petition recorded July 27, 1864.

1931. Charles Garton, Bristol, and Thomas Hill, Southampton, "Improvements in mashing apparatus."—Petition recorded August 3, 1864.

Notices to Proceed.

769. John Lightfoot, Accrington, Lancashire, "Improvements in dyeing and printing textile fabrics and yarns, and in fixing more permanently certain mordants thereon."—Petition recorded March 28, 1864.

782. Arthur Heald, Sabden Whally, Lancashire, "An

improved composition for sizing yarns and threads."—Petition recorded March 29, 1864.

791. Thomas James Smith, Twickenham, Middlesex, "Improvements in the purification, distillation, rectification, evaporation, condensation, concentration, and oxygenation of spirits and spirituous liquors, and in the apparatus employed therein, and in raising and forcing the same, parts of which are applicable to the manufacture of vinegar, to the raising and forcing of liquids, to the heating, cooling, and oxygenating of beers and liquids, and to the construction of chimneys."—A communication from François Haeck, Brussels, Belgium.—Petition recorded March 30, 1864.

809. James Hicks, Hatton Garden, Middlesex, "An improved maximum mercurial thermometer."—Petition recorded April 1, 1864.

876. Joseph Strangman Richardson, Waterford, Ireland, "Improvements in preparing the carcasses of pigs and other animals for curing."—Petition recorded April 7, 1864.

928. John Campbell Evans and John Calvin Thompson, East Greenwich, Kent, "Improvements in preserving the bottoms of iron and other ships and vessels."—Petition recorded April 13, 1864.

1017. George Fellows Harrington, Ryde, Isle of Wight, "Improvements in machinery or apparatus for drilling, cutting, grinding, and polishing teeth whilst in the mouth."—Petition recorded April 22, 1864.

1038. John Frederick Brinjes, Fieldgate Street, Whitechapel, Middlesex, "Improvements in apparatus for the reburning of animal charcoal."—Petition recorded April 23, 1864.

1095. Richard Archibald Brooman, Fleet Street, London, "Improvements in tanning."—A communication from Barthelemy Picard, Pateaux, France.—Petition recorded April 30, 1864.

1131. Charles James Richardson, Kensington Square, Middlesex, "Improvements in arranging steam boiler and other furnaces, in order to render them more suitable for burning petroleum and like oils."—Petition recorded May 4, 1864.

1199. Otto Sachs, Aldermanbury, London, "Improvements in the manufacture of aniline dye colours."—A communication from Richard Froehling, Berlin, Prussia.—Petition recorded May 12, 1864.

1786. John Clayton, West Bromwich, Staffordshire, "Improvements in furnaces for heating and melting iron and steel, and for other purposes."—Petition recorded July 16, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, August 13.

THE piscicultural experiments that are being made at the Brussels Botanic Gardens under the direction of M. Schram are going on most satisfactorily. The ova were sent from the French establishment at Huningue about five years ago, and have gone through all their normal changes in the most exemplary manner. Several of the lake trout taken out of the ponds in the month of November last weighed as much as 8 lbs.—a development they hardly ever reach in their native Swiss lakes. Many of them have milted and spawned, and the fecundated ova hatched out in such large numbers that the directors were quite taken by surprise, and many of the fish were lost.

M. Nelaton has lately applied voltaic electricity to the reduction of tumours of various kinds, more especially of polypus in the nose. The platinum electrodes of a small battery are inserted in the tumour, which gradually gives way under the decomposing action of the current, coagulation taking place at the positive pole; liquefaction at the negative. The pain caused by the operation is comparatively slight, and six applications of the powerful agent

were sufficient to destroy a polypus that had resisted all endeavours to remove it.

M. Kaiser, of Leipzig, has discovered that the modification of iodide of silver, which is insensitive to light, may be transformed into the sensitive iodide by being submitted to the vapour of benzol. He says that the benzol vapour acts by developing ozone in the air, in which it is suspended, having found that an atmosphere ozonised by electricity has precisely the same action. This idea is easily carried out, and would repay a few experiments on the part of some of your photographic readers. Every one has remarked that on days when the atmosphere is full of ozone, the collodion plate is always more sensitive than on other occasions; but as on such days the light is generally of the most brilliant character, it is somewhat difficult to distinguish between the *post hoc* and the *propter hoc*. M. Kaiser's experiments with benzol vapour seem to confirm a suspicion entertained by many photographers that the wet collodion plate is more sensitive than any other from containing a small quantity of ozonised ether on its surface, and not because its pores are more open in the wet state than when dry.

M. Pavesi, of Mortara, has lately been experimenting on the vesicating properties of an alcoholic tincture of the *fresh* leaves, stalks, and flowers of the common buttercup. Every one knows that this very neglected plant contains an acrid juice, but I am not aware that it has ever been utilised up to the present time. The tincture preserves its epispastic qualities for a long time, and is much cheaper, of course, than cantharides, and besides has no action on the urinary organs. A weak solution forms an excellent rubefacient.

Several of our scientific journals here, whose editors ought to know better, have been repeating the ridiculous story concerning the great cheapness of petroleum as a fuel for steam vessels as compared with coal. You will remember that your leading journal, the great Jupiter Tonans of Printing House Square, swallowed this story whole, and published a leader on the subject, which made that organ the laughing-stock of all the scientific men in England. The whole thing is so apparently absurd that it is hardly worth while to refute it. Granting that from experiments made by the American Commissioners appointed to inquire into the matter that the heating power of a pound of petroleum is equal to twice that of a pound of coal (which I doubt), it must be remembered that the former fuel is, at the lowest calculation, eighteen to twenty times as dear as the latter. When petroleum is sold at only double the price of coal it will be time to talk of using it as fuel. But even then a ton of petroleum would take up twice the room of a ton of coal, to say nothing of the danger of employing the unrefined oil for such a purpose. However, it is not likely that petroleum will ever be cheaper than it is at present; so we may leave the finders of the mare's nest to gloat over their prize. It is, however, pitiful to see journals of eminence gravely discussing a question which a glance at a price current would at once decide.

Phillips' Translation of the Pharmacopœia.

To the Editor of the CHEMICAL NEWS.

SIR,—I do not doubt that the law of copyright would forbid the sale of a work "on the British Pharmacopœia of the same character as Mr. Phillips' Translations of former London Pharmacopœis," at the absence of which you express a kindly surprise in the last number of your journal.

To import the entire text of a book recently published into another work without the consent of the owners of the first, and to publish this with remarks, a plan which is the very basis of Phillips' Translations, as a separate book, is, to my mind, unjustifiable; whilst to apply to the Medical Council for such consent would, of course, be futile, since every sale of a copy of such a book would

prevent the sale of a copy of the British Pharmacopœia; whilst to publish the remarks without the text would not only be a wide departure from the distinctive character of Phillips' Translations, but would prove to be, from its inevitable incompleteness, but of secondary value to the student and pharmacist, and would probably result in the loss both of time and money had such a work been published.

Still, a small book containing a brief description of the officinal substances, and concise notes on the preparations of the British Pharmacopœia, with the requisite tables as an appendix, would be likely to be useful, and therefore saleable, were it not that custom, as I am informed, still sanctions the use of the preparations of the London Pharmacopœia of 1851; whilst rumour attributes to the Medical Council an intention to follow the example of the London College in 1788, and issue an amended edition of the British Pharmacopœia. Few persons competent to form an opinion would dissent from the wisdom and expediency of such a course, but until it is authoritatively known whether the Medical Council intend to adhere to the present, or to issue an amended edition of their Pharmacopœia, it would be idle to devote much time or expend money on a book supplementary to the present edition of the British Pharmacopœia. I am, &c.

THE EDITOR OF "PHILLIPS' TRANSLATION OF
THE LONDON PHARMACOPŒIA," 1851.

16, Park Terrace, Highbury, N., August 15.

[In the opinion of eminent lawyers it is very doubtful whether a copyright can exist in a book like the Pharmacopœia, which is binding on a section of the community. In any case there can be no difficulty in evading the law, as is done when an Act of Parliament is published with notes and forms.—ED. C. N.]

On Relations Among the Equivalents.

To the Editor of the CHEMICAL NEWS.

SIR,—In addition to the facts stated in my late communication, may I be permitted to observe that if the elements are arranged in the order of their equivalents, calling hydrogen 1, lithium 2, glucinum 3, boron 4, and so on (a separate number being attached to each element having a distinct equivalent of its own, and where two elements happen to have the same equivalent, both being designated by the same number), it will be observed that elements having consecutive numbers frequently either belong to the same group or occupy similar positions in different groups, as in the following examples:—

Group	a..		N	No.	P	No.	As	No.	Sb	No.	Bi	No.
"	b..		O	7	S	13	Se	26	Te	40	Os	54
"	c..		Fl	8	Cl	14	Br	27	I	42	—	—
"	d..		Na	9	K	15	Rb	28	Cs	41	—	—
"	e..		Mg	10	Ca	16	Sr	29	Ba	43	Tl	52
								30		44	Pb	53

Here the difference between the number of the lowest member of a group and that immediately above it is 7; in other words, the eighth element starting from a given one is a kind of repetition of the first, like the eighth note of an octave in music. The differences between the numbers of the other members of a group are frequently twice as great; thus in the nitrogen group, between N and P there are 7 elements; between P and As, 13; between As and Sb, 14; and between Sb and Bi, 14.

In conclusion, I may remark that just as we have several examples of the apparent existence of triads, the extremities of which are known, whilst their centres are wanting (such as the metals of the platinum group, which may be conceived to be the extremities of three distinct triads, and perhaps also silver and gold may be related to each other in this manner), so we may look upon certain of the elements, *e.g.*, Mn, Fe, Co, Ni, and Cu, as the centres of

triads, the extremes of which are at present unknown, or, perhaps, in some instances only unrecognised.

I am, &c.

JOHN A. R. NEWLANDS, F.C.S.

Laboratory, 19, Great St. Helens, E.C., August 8.

Equivalent of Indium.

To the Editor of the CHEMICAL NEWS.

SIR,—In reply to "Inquirer," who asks me to give him some idea of the equivalent of indium, I am afraid that our knowledge of this metal is too imperfect to enable us to give a satisfactory answer to such a question.

Professor Roscoe has stated (CHEMICAL NEWS, June 25, 1864), that indium "in its chemical relations resembles zinc, with which it is associated in nature," and taking this statement as the best existing basis on which to build our notions regarding its equivalent, we should expect to find that the atomic weight of indium bears some simple relation to those of the zinc group, including under that term magnesium, zinc, cadmium, and, perhaps, mercury. The equivalent of indium, then, may prove to be identical, or nearly so, with those of zinc or cadmium. I leave magnesium out of the question, as it is not likely that indium, from its known properties, has an equivalent lower than 50. It is also just possible that indium may occupy a position in the zinc group similar to that of thallium among the alkali metals, in which case the equivalent of indium would be 182, or thereabouts.

I am, &c.

JOHN A. R. NEWLANDS, F.C.S.

Laboratory, 19, Great St. Helens, E.C., August 15.

Numerical Relations of Equivalents.

To the Editor of the CHEMICAL NEWS.

SIR,—Few would call chemistry a mathematical science; and, such being the case, I appeal against its being treated mathematically, as it was by Mr. Newlands in your impression of the 30th ult.

Mr. Newlands there gave a table constructed for the purpose of disproving that "the atomic weights are multiples of eight;" but in so doing he deals with a statement which no one would for a moment make, mathematically speaking.

My assertion was that the atomic weights are, with few exceptions, either exactly or very nearly multiples of eight, and I would submit that it is too much to require that if the atomic weights are approximately multiples of eight, therefore any differences between them must be likewise multiples of eight.

Granting necessarily some amount of latitude (for atomic weights being merely results of experiment, and not mathematical, are therefore subject to error), it is easy to see that the difference between two atomic weights which are both close approximations to a multiple of eight may be very large, owing to divergence in opposite directions—e.g., lithium and glucinum both differ from eight by one, but in different directions, and therefore the difference between them is two; the same may be said of iodine (127), and tellurium (129), each differing from $(8 \times 16 =) 128$ by one, yet from one another by two. As a strong point in favour of this law, I would point to the list of atomic weights, fifteen in number, placed at the bottom of my former note, which are exactly multiples of eight.

In conclusion, I would state that the atomic weights which I have employed are those given in Professor Williamson's paper in the *Journal of the Chemical Society* for June last.

I am, &c.

STUDIOSUS.

MISCELLANEOUS.

Trial for Manslaughter.—The assistant of Messrs. Clay and Abrahams, of Liverpool, who some time ago dispensed strychnine for James's powder, was tried for

manslaughter last week and acquitted. It was stated in evidence that the strychnine was kept powdered for convenience in dispensing.

Poisoning by Calabar Beans(?)—The newspapers contain an account of the poisoning of seventy children at Liverpool from eating calabar beans. It is hardly likely that the poison was calabar bean; it is more probable that what the children ate were *Jatropha* nuts; and it will be remembered that a similar case happened with thirty boys only a short time ago.

A Colourless Varnish.—At the time the process of varnish-making by Luning was laid before the Society of Arts, Mr. Field put in a claim, when both the processes and products were found to answer the intended purpose, and the claimants were awarded twenty guineas each. Mr. Field describes his process as follows:—Six ounces of shellac, coarsely powdered, are to be dissolved by gentle heat in a pint of spirits of wine; to this is to be added a bleaching liquor made by dissolving carbonate of potash, and then impregnating it with chlorine gas till the solution becomes slightly coloured. Of this bleaching liquor add one or two ounces to the spirituous solution of lac, and stir the whole well together. Effervescence takes place. When this ceases add more of the bleaching liquor, and thus proceed till the colour of the mixture has become pale. A second bleaching liquor is now to be added, made by diluting muriatic acid with thrice its bulk of water, and dropping into it pulverised red lead till the last added portions do not become white. Of this acid bleaching liquor small quantities at a time are to be added to the half-bleached lac solution, allowing the effervescence which takes place on each addition to cease before a fresh portion is poured in. This is to be continued until the lac, now white, separates from the liquor. The supernatant fluid is now to be poured away, the lac well washed in repeated waters, and finally wrung as dry as possible in a cloth. The lac obtained by the foregoing process is to be dissolved in a pint of alcohol, more or less, according to the required strength of the varnish; and, after standing for some time in a gentle heat, the clear liquor—which is the varnish—is to be poured off from the sediment. When the processes of Luning and Field came before the Society of Arts, the Editor of the *Franklin Journal* (Philadelphia) made known the process of Dr. Hare, in which he stated that "all the objects sought for were perfectly attained, and left nothing to desire, save on the score of economy." The following was Dr. Hare's process:—Dissolve in an iron kettle one part of pearlash in about eight parts of water, add one part of seed or shellac, and heat the whole to ebullition. When the lac is dissolved, cool the solution, and impregnate it with chlorine till the lac is all precipitated. The precipitate is white, but its colour is deepened by washing and consolidation. Dissolve in alcohol. Lac bleached by this process yields a varnish as free from colour as any copal.—*British Journal of Photography*.

ANSWERS TO CORRESPONDENTS.

* * In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

* * All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

We have to acknowledge with thanks the receipt of the Report, for 1863, of the Commissioner of Patents for the United States, with two volumes of patents and drawings, liberally forwarded by the Government of the United States.

A G.—Precipitate it in the metallic state by placing a strip of copper in the solution. The precipitate will be pure silver.

A Student should write to Mr. H. Cole at the Museum, South Kensington.

TABLE OF SYMBOLS, ATOMIC WEIGHTS, &c.

By M. A. WURTZ.

Referred to in Lectures I. and II.

Elements.	Symbols of atomic weights.	New atomic weights.	Atomic weights of Berzelius.	Atomic weights of Gerhardt.	Symbols of equivalents.	Equivalent weights.
Hydrogen	H	1	1	1	H	1
Oxygen	O*	16	16	16	O	8
Nitrogen	N	14	14.02	14	N	14
Chlorine	Cl	35.5	35.52	35.5	Cl	35.5
Bromine	Br	80	80.09	80	Br	80
Iodine	I	127	127.08	127	I	127
Fluorine	Fl	19	18.70	19	Fl	19
Sulphur	S	32	32.17	32	S	16
Selenium	Se	79.5	79.37	79.5	Se	39.7
Tellurium	Te	129	128.48	129	Te	64
Phosphorus	P	31	31.41	31	P	31
Arsenic	As	75	75.22	75	As	75
Carbon	C	12	12.04	12	C	6
Boron †	Bo	11	21.82, of which the $\frac{1}{2}$ = 10.91	11	Bo	10.9
Silicium	Si	28	44.51, of which the $\frac{2}{3}$ = 29.66	„	Si	14
Zirconium ‡	Zr	89.6	67.26, of which the $\frac{4}{5}$ = 89.6	„	Zr	44.8
Potassium	K	39.1	78.47	39	K	39
Sodium	Na	23	46.43	23	Na	23
Lithium	Li	7	13.08	7	Li	7
Silver	Ag	108	216.29	108	Ag	108
Barium	Ba	137	137.06	68.5	Ba	68.5
Strontium	Sr	87.5	87.48	43.75	Sr	43.8
Calcium	Ca	40	40.32	20	Ca	20
Magnesium	Mg	12	25.34	12	Mg	12
Aluminium	Al	27	27.39	13.75	Al	13.7
Manganese	Mn	55	55.23	27.5	Mn	27.5
Chromium	Cr	53.5	52.70	26.25	Cr	26.7
Uranium	U	120	118.88	60	U	60
Iron	Fe	56	56.17	28	Fe	28
Cobalt	Co	59	59.07	29.5	Co	29.5
Nickel	Ni	59	59.19	29.5	Ni	29.5
Zinc	Zn	65.2	65.16	32.6	Zn	32.6
Cadmium	Cd	112	111.66	56	Cd	56
Copper	Cu	63.5	63.39	31.75	Cu	31.7
Lead	Pb	207	207.47	103.5	Pb	103.5
Bismuth	Bi	210	213.20	210	Bi	210
Tin	Sn	118	117.83	56	Sn	59
Titanium	Ti	50	48.3	137.32	Ti	25
Tungsten	Wo	184	190.44	92	Wo	92
Molybdenum	Mo	96	95.53	48	Mo	48
Vanadium	Va	137.2	137.32	48	Vd	68.5
Antimony	Sb	122	129.24	122	Sb	122
Mercury	Hg	200	200.52	100	Hg	100
Rhodium	Rh	104.4	104.48	„ „	Rh	52
Palladium	Pd	106.6	106.64	„ „	Pd	53.3
Platinum	Pt	197	197.44	98.5	Pt	98.7
Iridium	Ir	198	197.44	98.5	Ir	99
Ruthenium	Ru	104.4	„ „	„ „	Ru	52.2
Osmium	Os	199.2	199.13	„ „	Os	99.5
Gold	Au	197	196.98	„ „	Au	197

* Italics are used instead of barred letters for the double equivalents.

† The vapour densities of the chlorides of boron and silicium oblige us to represent them as BoCl_3 and SiCl_4 ; boric and silicic acid will therefore be Bo_2O_3 and SiO_2 . We thus halve the atomic weight Berzelius attributed to boron, and take two-thirds of that he adopted for silicium.‡ Berzelius represented zirconia as Zr_2O_3 . In adopting the formula ZrO_2 we increase the atomic weight of zirconium to $\frac{4}{5}$.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on Oxygen, by Dr. G. MEISSNER.

(Continued from page 74.)

THE greater part of the gas evolved in the process last described is, in fact, only ordinary oxygen, and, as was said, but a very weak solution of oxygenated water is obtained. A much stronger solution may be procured by decomposing peroxide of barium with carbonic acid, simply passing the acid through water mixed with the peroxide. The greater part of the oxygen set free in this way combines with the water, and we obtain in a short time a very concentrated solution—so concentrated, in fact, that it will begin to decompose on exposure to light.

The most delicate test for peroxide of hydrogen the author found to be that given by Schönbein—viz., iodide of potassium assisted by protosulphate of iron. By these reagents Schönbein was able to recognise distinctly the presence of $\frac{1}{50,000}$ th in a solution. Very dilute solutions both of the iodide of potassium and the protosulphate of iron must be employed.

Meissner, like Schönbein, believes that a perfectly neutral solution of pure peroxide of hydrogen alone will not decompose iodide of potassium, but with a “disposing” agent like the protosulphate of iron the reaction takes place immediately. Certain precautions are necessary in applying the test. The iodide of potassium with a little starch must first be mixed with the solution of the peroxide, and the solution of protosulphate added drop by drop to the mixture, waiting a short time between the addition of the drops for the blue colour to form. If too much protosulphate of iron be added, no iodine is set free. The author accounts for this by supposing that the first action which takes place is the oxidation of the protosulphate to the state of insoluble basic sulphate, and the action proceeding involves the iodide of potassium; but if too much sulphate of iron is added the whole of the oxygen liberated is used up in converting protosulphate into basic sulphate.

In continuation of his notice of the tests for HO_2 , the author mentions the fact first observed by Schönbein—that the presence of a small quantity of acid—sulphuric, nitric, or hydrochloric—in the solution prevents the decomposition of iodide of potassium (for some time, at all events), most probably by increasing the stability of the compound. But he adds that if the acid be introduced into a mixture—the iodide with a neutral solution of HO_2 —a decomposition takes place immediately.

Meissner proceeds to show that a very feebly acidulated solution of iodide of potassium, which contains no trace of iodate, gradually decomposes—a fact previously noticed by Baumert and Andrews; and he specially cautions the experimenter against the use of common commercial iodide, which usually contains iodate, or even pure iodide which has been kept in the laboratory where ozone is evolved; for he has found that in the latter case the crystals, without losing their whiteness, become partially converted into iodate. He then remarks on the difference between the action of acids and the protosulphate of iron on the mixed solutions of HO_2 and iodide of potassium. The former, he says, decompose the iodide and induce the decomposition of the HO_2 ; the latter, he states, decomposes the HO_2 , and induces the decomposition of the iodide.

The decomposition of iodide of potassium with HO_2 on the addition of an acid is by no means so sensitive a test

as the reaction with protosulphate of iron, and is, besides, open to the objection that it may only show the presence of iodate of potash.

Meissner next refers to Schönbein's discovery of the presence of antozone in the fluor spar found at Welsendorf. He repeated and confirmed all Schönbein's experiments with this curious substance. It was found that when a small quantity of the spar was rubbed in a porcelain mortar with just sufficient water to cover it, the water, when filtered, gave all the reactions of a solution of HO_2 . The behaviour of the water with the iodide of potassium differs somewhat, according as it is rubbed for a long or a short time with the spar. If rubbed but for a short time, the addition of the iodide of potassium results in the instantaneous separation of a very small amount of iodine; when the rubbing is continued for some time, however, the mixture of water and iodide will remain colourless for at least a minute, but the addition of solution of protosulphate of iron will immediately cause the decomposition of the iodide. The author agrees with Schönbein in supposing that in the former case the water contains free antozone simply dissolved, while by longer rubbing it becomes perfectly combined. This view is confirmed by the fact that the water which has been rubbed but for a short time and decomposes the iodide, loses its power to do so after a short boiling, which suffices to drive off free antozone, but does not destroy peroxide of hydrogen.

We need not follow the author through the other experiments by which he satisfied himself that the reactions of the fluor spar water were really those of peroxide of hydrogen, of which he entertains no doubt. He has nothing to say on the state in which antozone exists in the Welsendorf spar, nor does he explain how it is developed by the rubbing, but he states that he has experimented with a variety of other spars and minerals, some of which evolve a peculiar smell when rubbed, but with no one has he been able to produce the smallest trace of antozone.

The next so-called antozonide examined was oxidised oil of turpentine. This the author found to present the same reactions as the water rubbed with Welsendorf spar, and hence he concludes that this also contains peroxide of hydrogen, and also a “disposing” agent which, like protosulphate of iron, induces the decomposition of iodide of potassium.

(To be continued.)

On the Properties of Silicic Acid and other analogous Colloidal Substances, by THOMAS GRAHAM, F.R.S.*

(PRELIMINARY NOTICE.)

THE prevalent notions respecting solubility have been derived chiefly from observations on crystalline salts, and are very imperfectly applicable to the class of colloidal substances. Hydrated silicic acid, for instance, when in the soluble condition, is, properly speaking, a liquid body, like alcohol, miscible with water in all proportions. We have no degrees of solubility to speak of with respect to silicic acid, like the degrees of solubility of a salt, unless it be with reference to silicic acid in the gelatinous condition, which is usually looked upon as destitute of solubility. The jelly of silicic acid may be more or less rich in combined water, as it is first prepared, and it appears to be soluble in proportion to the extent of its hydration. A jelly containing 1 per cent. of silicic acid gives with cold water a solution containing about 1 of

* Abstracted from the *Proceedings of the Royal Society*, with additions by the author.

silicic acid in 5000 water; a jelly containing 5 per cent. of silicic acid gives a solution containing about 1 part of acid in 10,000 water. A less hydrated jelly than the last mentioned is still less soluble; and finally, when the jelly is rendered anhydrous, it gives gummy-looking white masses, which appear to be absolutely insoluble, like the light dusty silicic acid obtained by drying a jelly charged with salts in the ordinary analysis of a silicate.

The liquidity of silicic acid is only effected by a change, which is permanent (namely, coagulation or pectisation), by which the acid is converted into the gelatinous or pectous form, and loses its miscibility with water. The liquidity is permanent in proportion to the degree of dilution of silicic acid, and appears to be favoured by a low temperature. It is opposed, on the contrary, by concentration, and by elevation of temperature. A liquid silicic acid of 10 or 12 per cent. pectises spontaneously in a few hours at the ordinary temperature, and immediately when heated. A liquid of 5 per cent. may be preserved for five or six days; a liquid of 2 per cent. for two or three months; and a liquid of 1 per cent. has not pectised after two years. Dilute solutions of 0.1 per cent. or less are no doubt practically unalterable by time, and hence the possibility of soluble silicic acid existing in nature. I may add, however, that no solution, weak or strong, of silicic acid in water has shown any disposition to deposit *crystals*, but always appears on drying as a colloidal glassy hyalite. The formation of quartz crystals at a low temperature, of so frequent occurrence in nature, remains still a mystery. I can only imagine that such crystals are formed at an inconceivably slow rate, and from solutions of silicic acid which are extremely dilute. Dilution no doubt weakens the colloidal character of substances, and may, therefore, allow their crystallising tendency to gain ground and develop itself, particularly where the crystal once formed is completely insoluble, as with quartz.

The pectisation of liquid silicic acid is expedited by contact with solid matter in the form of powder. By contact with powdered graphite, which is chemically inactive, the pectisation of a 5 per cent. silicic acid is brought about in an hour or two, and that of a 2 per cent. silicic acid in two days. A rise of temperature of 1° C. was observed during the formation of the 5 per cent. jelly.

The ultimate pectisation of silicic acid is preceded by a gradual thickening in the liquid itself. The flow of liquid colloids through a capillary tube is always slow compared with the flow of crystalloid solutions, so that a liquid-transpiration-tube may be employed as a colloidoscope. With a colloidal liquid alterable in viscosity, such as silicic acid, the increased resistance to passage through the colloidoscope is obvious from day to day. Just before gelatinising silicic acid flows like an oil.

A dominating quality of colloids is the tendency of their particles to adhere, aggregate, and contract. This idio-attraction is obvious in the gradual thickening of the liquid, and when it advances leads to pectisation. In the jelly itself, the specific contraction in question, or *synæresis*, still proceeds, causing separation of water, with the division into a clot and serum; and ending in the production of a hard stony mass, of vitreous structure, which may be anhydrous, or nearly so, when the water is allowed to escape by evaporation. The intense *synæresis* of isinglass dried in a glass dish over sulphuric acid *in vacuo* enables the contracting gelatin to tear up the surface of the glass. Glass itself is a colloid, and the adhesion of colloid to colloid appears to be more powerful than that of colloid to crystalloid. The ge-

tin, when dried in the manner described upon plates of calespar and mica, did not adhere to the crystalline surface, but detached itself on drying. Polished plates of glass must not be left in contact, as is well known, owing to the risk of permanent adhesion between their surfaces. The adhesion of broken masses of glacial phosphoric acid to each other is an old illustration of colloidal *synæresis*.

Bearing in mind that the colloidal phasis of matter is the result of a peculiar attraction and aggregation of molecules, properties never entirely absent from matter, but greatly more developed in some substances than in others, it is not surprising that colloidal characters spread on both sides into the liquid and solid conditions. These characters appear in the viscosity of liquids, and in the softness and adhesiveness of certain crystalline substances. Metaphosphate of soda, after fusion by heat, is a true glass or colloid; but when this glass is maintained for a few minutes at a temperature some degrees under its point of fusion, the glass assumes a crystalline structure without losing its transparency. Notwithstanding this change, the low diffusibility of the salt is preserved, with other characters of a colloid. Water in the form of ice has already been represented as a similar intermediate form, both colloid and crystalline, and in the first character adhesive and capable of reunion or "regelation."

It is unnecessary to return here to the fact of the ready pectisation of liquid silicic acid by alkaline salts, including some of very sparing solubility, such as carbonate of lime, beyond stating that the presence of carbonate of lime in water was observed to be incompatible with the co-existence of soluble silicic acid, till the proportion of the latter was reduced to nearly 1 in 10,000 water.

Certain liquid substances differ from the salts in exercising little or no pectising influence upon liquid silicic acid. But, on the other hand, none of the liquids now referred to appear to conduce to the preservation of the fluidity of the colloid, at least not more than the addition of water would do. Among these inactive diluents of silicic acid are found hydrochloric, nitric, acetic, and tartaric acid, syrup of sugar, glycerine, and alcohol. But all the liquid substances named, and many others, appear to possess an important relation to silicic acid, of a very different nature from the pectising action of salts. They are capable of displacing the combined water of the silicic acid hydrate, whether that hydrate is in the liquid or gelatinous condition, and give new substitution products.

A liquid compound of *alcohol* and silicic acid is obtained by adding alcohol to aqueous silicic acid, and then employing proper means to withdraw the water from the mixture. For that purpose the mixture contained in a cup may be placed over dry carbonate of potash or quicklime, within the receiver of an air-pump. Or a dialysing bag of parchment paper containing the mixed alcohol and silicic acid may be suspended in a jar of alcohol: the water diffuses away, leaving in the bag a liquid composed of alcohol and silicic acid only. A point to be attended to is, that the silicic acid should never be allowed to form more than 1 per cent. of the alcoholic solution, otherwise it may gelatinise during the experiment. If I may be allowed to distinguish the liquid and gelatinous hydrates of silicic acid by the irregularly-formed terms of *hydrosol* and *hydrogel* of silicic acid, the two corresponding alcoholic bodies now introduced may be named the *alcosol* and *alcogel* of silicic acid.

The *alcosol* of silicic acid, containing 1 per cent. of the latter, is a colourless liquid, not precipitated by water or salts, nor by contact with insoluble powders, probably from the small proportion of silicic acid present in solution. It may be boiled and evaporated without change, but is gelatinised by a slight concentration. The alcohol is retained less strongly in the *alcosol* of silicic acid than water is in the *hydrosol*, but with the same varying force, a small portion of the alcohol being held so strongly as to char when the resulting jelly is rapidly distilled at a high temperature. Not a trace of silicic ether is found in any compound of this class. The jelly burns readily in the air, leaving the whole silicic acid in the form of a white ash.

The *alcogel*, or solid compound, is readily prepared by placing masses of gelatinous silicic acid, containing 8 or 10 per cent. of the dry acid, in absolute alcohol, and changing the latter repeatedly till the water of the hydrogel is fully replaced by alcohol. The *alcogel* is generally slightly opalescent, and is similar in aspect to the hydrogel, preserving very nearly its original bulk. The following is the composition of an *alcogel* carefully prepared from a hydrogel which contained 9.35 per cent. of silicic acid:—

Alcohol	88.13
Water	0.23
Silicic acid	11.64
	<hr/>
	100.00

Placed in water, the *alcogel* is gradually decomposed—alcohol diffusing out and water entering instead, so that a hydrogel is reproduced.

Further, the *alcogel* may be made the starting point in the formation of a great variety of other substitution jellies of analogous constitution, the only condition required appearing to be that the new liquid and alcohol should be intermiscible, that is, interdiffusible bodies. Compounds of ether, benzole, and bisulphide of carbon have thus been produced. Again, from *etherogel* another series of silicic acid jellies may be derived, containing fluids soluble in ether, such as the fixed oils.

The preparation of the *glycerine* compound of silicic acid is facilitated by the comparative fixity of that liquid. When hydrated silicic acid is first steeped in glycerine, and then boiled in the same liquid, water distils over, without any change in the appearance of the jelly, except that when formerly opalescent it becomes now entirely colourless, and ceases to be visible when covered by the liquid. But a portion of the silicic acid is dissolved, and a *glycerosol* is produced at the same time as the glycerine jelly. A glycerogel prepared from a hydrate containing 9.35 per cent. of silicic acid was found by a combustion analysis to be composed of—

Glycerine	87.44
Water	3.78
Silicic acid	8.95
	<hr/>
	100.17

The glycerogel has somewhat less bulk than the original hydrogel. When a glycerine jelly is distilled by heat it does not fuse, but the whole of the glycerine comes over, with a slight amount of decomposition towards the end of the process.

The compound of sulphuric acid, *sulphagel*, is also interesting from the facility of its formation, and the complete manner in which the water of the original hydrogel is removed. A mass of hydrated silicic acid may be preserved unbroken if it is first placed in sulphuric acid diluted with two or three volumes of water,

and then transferred gradually to stronger acids, till at last it is placed in concentrated oil of vitriol. The *sulphagel* sinks in the latter fluid, and may be distilled with an excess of it for hours without losing its transparency or gelatinous character. It is always somewhat less in bulk than the primary hydrogel, but not more, to the eye, than one-fifth or one-sixth part of the original volume. This *sulphagel* is transparent and colourless. When a *sulphagel* is heated strongly in an open vessel, the last portions of the monohydrated sulphuric acid in combination are found to require a higher temperature for their expulsion than the boiling point of the acid. The whole silicic acid remains behind, forming a white, opaque, porous mass, like pumice. A *sulphagel* placed in water is soon decomposed, and the original hydrogel reproduced. No permanent compound of sulphuric and silicic acids, of the nature of a salt, appears to be formed in any circumstances. A *sulphagel* placed in alcohol gives ultimately a pure *alcogel*. Similar jellies of silicic acid may readily be formed with the monohydrates of nitric, acetic, and formic acids, and are all perfectly transparent.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On Digitaline, by M. LEFORT.

THE following account of the two foreign digitalines met with in commerce will be of interest to English readers, since this country is, we believe, entirely supplied with the article from Continental sources:—

1. **German or Soluble Digitaline.**—This is said by the author to be made by Merck, of Darmstadt. It is of a yellowish white colour, neutral to test paper, completely and readily soluble in water and alcohol. It is, on the contrary, but slightly soluble in ether, sulphide of carbon, and benzole. Tannin completely precipitates it from an aqueous solution. In one particular it will be seen, that of solubility in water, this article differs essentially from that described in the British Pharmacopœia.

When the powder is dropped into hydrochloric acid it immediately dissolves, forming a yellow solution, which gradually turns brown and finally becomes green. The green colour, however, is less bright than that given by the insoluble digitaline to be presently described, and the solution also remains transparent longer.

As the green colour is developed the solution becomes turbid, and emits an odour resembling that of powdered digitalis or the tincture, and deposits a brown substance, which seems to be a compound of digitaline or of one of the principles accompanying with hydrochloric acid.

When exposed to the vapour of hydrochloric acid this soluble digitaline turns rapidly brown, but exhibits no green colour.

Examined by a microscope with a high power the powder is seen to consist of small semi-transparent fragments, sometimes presenting sharp edges, but of no definite crystalline form. An alcoholic solution evaporates spontaneously to a clear varnish, and no trace of crystallisation can be observed.

2. **French, or Insoluble Digitaline.**—The colour of French digitaline varies from a yellowish white to a bright yellow. It is but very slightly soluble in cold water, a litre only dissolving about 0.50 gramme; it is very soluble in alcohol. Sulphuric ether, sulphide of carbon, and benzole dissolve a small quantity; tannin precipitates it from a saturated aqueous solution.

The powder dropped into hydrochloric acid gives a yellow solution which, in a few minutes, passes from a bright to a deep green, according to the quantity of digitaline employed; but as the green tint is produced, a deep green-coloured substance is deposited, and a smell of digitalis is evolved.

When exposed to the vapour of hydrochloric acid it is first coloured yellow, then brown, and afterwards green, the characteristic smell of digitalis becoming very apparent. The green powder (like the fresh powder of fox-glove leaves) becomes partially decolorised by exposure to sunlight, but the colour can be restored by another exposure to the vapours of the acid.

This last reaction suffices to distinguish between soluble and insoluble digitaline, and the author considers it sufficient to prove the presence of the latter.

An alcoholic solution of French digitaline (Menier's), left to evaporate spontaneously, and then examined by the microscope, showed a multitude of small spots, sometimes round and sometimes oval, which gave to the residue the cellular aspect of organised structure. This appearance the author considered to support the opinion of Homolle, who supposed that insoluble digitaline was never a single and constant product; and he, in fact, determined that French digitaline contained some volatile matter which communicated its characteristic odour.

The whole of M. Lefort's experiments showed that French and German digitaline differ considerably in their chemical and physical properties, and he is disposed to infer that as great differences may be found in their therapeutical properties.

With regard to the separation of digitaline by means of dialysis, the author found that a simple solution of the substance quickly dialysed, and the digitaline could easily be found in the diffusate. But when a mixture with animal and vegetable substances was placed on the dialyser, the deposit obtained on evaporating the diffusate gave but indistinctly the characteristic reactions of digitaline. Among these characters the most conclusive appear to be the bitterness of taste, the green coloration of liquid hydrochloric acid, and the development of the peculiar odour of digitalis on exposure to the vapour of hydrochloric acid.

[It may interest some of our readers to know that the volume of Gmelin's "Chemistry" just issued contains an excellent account of digitalis, and the various processes for obtaining it.—ED. C. N.]

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE V.*

DELIVERED ON THURSDAY EVENING, MAY 5, 1864.

BILE, its properties. Blood, its composition, and application in the refining of sugar and manufacture of albumen. Albumen, its application to calico-printing and photography. Milk, its composition, properties, falsification, and preservation. Urine, its uses. A few words on putrefaction.

In this lecture we shall examine the composition of the various liquids secreted in the human body and in those of animals, and the uses to which these fluids are applied in arts and manufactures:

Bile.—The composition and appearance of bile vary greatly in different animals. Usually it is a yellow, green, or brown, thick fluid, with a marked alkaline reaction,

and containing about 14 per cent. of solid matter, the most important constituents of which are, in human bile, mucus, two colouring matters, one yellow (*cholepyrrrhine*) the other green (*biliverdine*), sugar, albumen, two organic acids (*cholic and choleic*), combined with soda, oleate and margarate of soda, a non-saponifiable fatty matter (*cholesterine*), and several mineral salts. The two most interesting substances in bile are choleic acid and cholesterine, which when produced in undue proportion, give rise to those calculi, the passage of which through the biliary duct is so dangerous and painful. One of the most valuable papers published of late is that of Mr. G. Kemp, in the *Transactions* of the Royal Society, on the conversion of the hepatic bile into cestic,—thus he has shown that as the former is secreted by the liver, and arrives by the biliary duct into the gall bladder, it is there converted into cestic bile by means of a special fermentation induced by a mucus secreted in the walls of the gall bladder. It is believed by most physiologists that the principal function of bile is to neutralise the acid fluids resulting from digestion in the stomach, as they enter the small intestines, rendering them better adapted for their sojourn there, and also facilitating their fermentation, one of the most important phenomena of digestion. The employment of bile as a scouring agent has much diminished of late years owing to the substitution for it of benzine and Sherwood spirit.

Blood.—The study of this all-important fluid is most interesting, in a physiological point of view, for the twenty-seven pounds of blood (the average amount in an adult) which travels through the whole of the human frame in about three minutes, fulfils three distinct functions—viz., it carries the various elements of food, as modified by digestion, into the different parts of the body requiring them; it helps to remove from the system those substances which have fulfilled their required functions in it, and which have been rendered useless by the wear and tear of life; and it conveys through the system the heat generated by the oxidation, through respiration, of the substances which have been absorbed during digestion, as well as of those which have performed their part in the human economy, and require to be removed therefrom. It will, therefore, be easily understood that blood must be a complicated fluid; and the following table will give an idea of the truth of this assertion:—

1000 parts of blood.	
130.85 of clot	Fibrine 2.95
	Globules 125.63
	Hematosine 2.27
	Water 790.37
869.15 of serum.	Albumen } 67.80
	Soda }
	Phosphate of Soda
	Lactate of do.
	Carbonate of do.
	Chloride of Sodium
	„ of Potassium
	Carbonate of Lime
	„ of Magnesia
	Ammoniacal Salts
	Phosphate of Lime
	„ of Magnesia
	Sulphate of Potash
	Fatty Acids, free or combined
1000.00	Cholesterine
	Lecithine (phosphuretted fat)
1000.00	Ceribrine, or nitrogenated fat

It will facilitate our study of this complicated fluid if we class the various compounds existing in it under six different heads. Firstly, if blood, immediately after being drawn from an animal, is whipped with a birchrod, the

* This lecture was No. VI. when the course was delivered, but the present order of publication has been adopted, as bringing the whole subject more systematically before the reader.

ends of the twigs will have hanging from them a stringy mass, which after being well washed is grey and elastic, and is called *fibrine*. Secondly, if the blood so treated is mixed with a solution of sulphate of soda of sp. gr. 1.16, and the whole thrown on a filter, the *corpuscles* and the colouring matter called *hematosine*, will remain on the filter, and these substances, with the fibrine, form, as shown in the table, the clot of blood. Further, if the matter left on the filter is treated with concentrated acetic acid, the colouring matter is dissolved and the corpuscles are left as yellow discs. Thirdly, on boiling the fluid which passes through the filter, albumen is coagulated and can be easily separated, leaving water and a few saline substances which are easily separated by evaporating the liquid portion. Allow me now to add a few remarks on some of the substances above mentioned. Fibrine represents the fibrous or muscular part of animals, but has no direct application in manufactures. The blood corpuscles in man are ellipsoid discs, containing the colouring matter of blood. The most interesting fact connected with the latter is that it is united with a compound containing iron; and although iron does not appear to be an integral part of the colour, still its presence appears essential to the existence of the colour itself. The external part of the discs is composed of fibrine, whilst the interior contains an albuminous fluid (which differs from the albumen of the serum in the fact that it is not coagulated by heat) and which is called globuline. The relative proportion of fibrine, globuline, and hematosine, vary considerably in different individuals, according to health, age, and sex, and even during the process of digestion. When blood is examined under the microscope, large colourless globules are found to float with those just described. Dr. William Roberts, of Manchester, who has examined the corpuscles of blood, has observed that when they are dipped into a solution of magenta, they assume not only a pink colour, but that the nucleus of the disc acquires a much deeper shade. Further, that on the sides of the disc there are small projections which he calls pullulations, and which acquire a much deeper tint than the remainder of the discs when plunged into the magenta solution. Another curious fact lately observed by M. Pasteur is that if blood is kept for several weeks in a cold situation, air being excluded, the corpuscles disappear, and are replaced by myriads of beautiful red well-defined crystals. Lastly, there is a slight difference of composition between arterial and venous blood.

	Arterial.	Venous.
Carbon	50.2	55.7
Nitrogen	16.3	16.2
Hydrogen... ..	6.6	6.4
Oxygen	26.3	21.7
	99.4	100.0

It is strange that while blood is so extensively employed on the Continent in various branches of manufacture that in Paris 2000 tons of blood are used by sugar refiners alone, hardly any such application of this fluid is made in our own country. It appears to me that the explanation is to be found in the fact that on the Continent beasts are generally slaughtered in public abattoirs, by which means many of the refuse matters can be collected with advantage, and without being spoilt or polluted by unscrupulous persons, whilst in this country, where animals are slaughtered in innumerable private slaughterhouses, the difficulty and expense of collection, together with the absence of guarantee of quality, render the successful use of blood on a large scale impracticable. There is an additional advantage in the system of public abattoirs, which I cannot help noticing *en passant*—viz., the guarantee thereby obtained that the public food is not furnished from diseased animals. The only employment of blood in its integrity in this country is as an article of diet, and to some extent in the manufacture of prussiate

of potash. The serum of blood is sometimes used in England, as well as on the Continent, as one of the substances essential in the process followed to communicate to cotton the magnificent colour called "Turkey red."

Albumen (blood).—The employment of this substance in the art of calico printing is of comparatively recent date, as it is chiefly due to the introduction of the tar colours and pigment styles into that art. To fix colours with this albumen (or that of egg) it is only necessary to dissolve in a gallon of water several pounds of albumen and gum Senegal, adding a little tar colour, such as magenta, &c., or a pigment, such as ultramarine blue; these mixtures are then printed on the cotton fabric, and the colour fixed by the coagulation of the albumen under the influence of high pressure steam. But the quantity of albumen used for this purpose has greatly decreased of late years, owing to the introduction of tannin by Mr. Charles Lowe and myself, Messrs. Roberts, Dale, and Co., and Mr. Gratrix, and also that of the arseniate of alumina by Mr. W. A. Perkin. The substitution of blood albumen for that of egg is chiefly due to Messrs. Robart, Roger, and Co., who, I believe, prepare it by separating carefully the serum of blood from the clot, adding to it a small quantity of alum to separate any colouring matter that may be mixed with it, and evaporating the water of the serum by a current of air heated to 100°, which leaves the albumen in the form of yellowish scales, freely soluble when placed again in contact with water. The most abundant source of albumen, however, is the white of egg, and, therefore, let us glance at a few facts connected with this substance, doubly important as an article of manufacture and as one of food. To give some idea of the extensive use of eggs, I may state that in Paris there are annually consumed 178,000,000 eggs, weighing 28,000,000 lbs. The composition of a hen's egg may be stated to be as follows:—

Shell	11.5
White	58.5
Yolk	30.0
	100.0

The following are the respective compositions of the yolk and white:—

Yolk.		White.	
Water ...	... 51.47	Water ...	... 86.34
Vitelline	... 15.76	Albumen ...	.. 12.50
Oleine	} ... 28.97	Membrane ...	... 0.50
Margarine		Phosphates, Chlorides,	
Cholesterine		&c. ...	... 0.66
Phospho-glyceric acid	1.26		<hr/>
Colouring matters	1.20		100.00
Mineral salts ...	1.34		
	<hr/>		
	100.000		

An egg may be considered as consisting of four parts, the shell, membrane, white, and yolk. The shell is composed of carbonates of lime and magnesia, phosphate of lime, and oxide of iron, the whole bound together by a nitro-sulphuretted substance. The presence of sulphur in this substance, as well as in albumen, explains why eggs give off sulphuretted hydrogen when boiled. The membrane lining the shell is also a nitro-sulphuretted substance, much resembling in its composition that of horn. I have already had occasion to speak of the interesting composition of the yolk of egg, when mentioning its application in the glove manufacture, and on that occasion I drew your attention to the remarkable substance called vitelline, and to the peculiar nature of the fats contained in yolk of eggs, but more especially the phospho-glyceric acid, and attributing to them the peculiar properties imparted to leather through their use. The white of egg chiefly consists, as the above table shows, of a substance called albumen, which you will remember is also found in blood, and, I may add, that it exists in the sap of all plants.

Albumen is a fluid of an alkaline reaction, soluble in water, and coagulates at 160° when undiluted, but when dissolved in water the temperature at which it coagulates is raised according to the extent of its dilution. Albumen gives a precipitate with all metallic salts, but one of the most characteristic and delicate tests for albumen in solution is bichloride of mercury or corrosive sublimate. In fact, albumen is the best antidote known to the action of this violent poison, when taken internally, as was proved by its saving the life of a most eminent chemist (Baron Thenard) in 1825. All acids, except phosphoric and acetic, precipitate albumen from its solutions, but that which separates it with the greatest nicety is nitric acid. When placed in contact with hydrochloric acid for a few hours, it assumes a very beautiful purple colour. When albumen is placed in shallow vessels, and then stored in a chamber where air at 100° is allowed to circulate, the water evaporates, and leaves the solid albumen in the form of yellowish semi-transparent scales, which, strange to say, will, if kept dry, resist putrefaction for any length of time, although in its liquid form the large amount of nitrogen it contains renders it highly putrescible. It is this solid albumen which is used by calico printers, as it is easily dissolved in water, and rendered applicable to their purposes. Albumen is often used in manufactures to clarify fluids. In some instances the albumen in solution is added to the fluid and carried to the boil, when the dissolved albumen coagulates, and in falling through the fluid carries with it mechanically the matters in suspension, when it is only necessary to decant the clarified fluid. In others it is added at natural temperature, as in the case of wines, where the tannin, alcohol, and acids are the agents which coagulate the albumen. Albumen was first applied to photography by Niepce de St. Victor, in the following form:—He mixed together intimately 10 fluid ounces of distilled water with the white of 10 fresh eggs; to this he added 200 grains of chloride of sodium or chloride of ammonium. The whole was well shaken in a bottle for about ten minutes, and then allowed to stand. All that was then required was to decant the clear liquor, and apply it to the surfaces intended to receive the photographic image. [Here the lecturer shortly described this photographic process, and alluded to the recent application of the light resulting from the combustion of magnesium wire, manufactured by Messrs. J. Mellor and Co., of Salford, showing its applicability to photography, by using this light to take photographs during the lecture, stating that the cost was only a few pence.] A great many attempts have been made to preserve eggs from decay, the most successful of which have been those of Le Maison Cormier du Mans, who covers the egg with an impermeable varnish, packing them in sawdust, so that the egg shall always rest on one end. Another process is that of immersing the eggs in lime water. Lastly, the whole of the egg has been emptied out of the shell and evaporated to a solid mass. I must not conclude the subject of the albuminous and vitelline substances without calling your attention to the following table, which will give an idea of the different albumens and vitellines which Mr. E. Fremy has succeeded in isolating and characterising:—

EGGS OF BIRDS.

Albumen	coagulated by heat	
Eudophasine	" "	All these substances are characterised by containing sulphur.
Albumen	" acid	
Meta albumen	" neither	
Exophasine	" "	

EGGS OF FISHES.

Ray	Ichthine	All these substances are characterised by containing phosphorus,
Goldfish	Ichthidine	
Carp		
Salmon	Icthuline and Salmonic acid	
Turtle	Eurydine	

(To be continued.)

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 13.

JOHN SCOTT RUSSELL, Esq., C.E., F.R.S., read a paper "On the Mechanical Nature and Uses of Gun-cotton."*

Gun-cotton is a new power coming under the same category as steam and gunpowder. It is highly dangerous to those who do not possess the necessary knowledge and skill; but, like them, it enormously extends human power, and like them, the skill to use it can be rightly and certainly acquired.

I. Is gun-cotton stronger than gunpowder? The answer to this is, Yes, sixfold stronger.

By this we mean that if we take a given weight of gun-cotton, say 4 ounces, if we bore a hole $1\frac{1}{2}$ inch in diameter and 3 feet deep, into hard rock or slate, in a quarry, and put 4 ounces of gun-cotton into it, it will occupy about 1 foot of its length, and the aperture being closed in the usual manner, and a matchline led from the charge to the proper distance from which to fire it; and if we next take 24 ounces of best gunpowder, bore a similar hole, and charge it similarly with gunpowder, and close it in the same way, it has been found that, on these being exploded, the 4 ounces of gun-cotton have produced greater effect, in separating the rock into pieces, than the 24 ounces of gunpowder. The answer is, therefore, that in disruptive explosion the strength of gun-cotton is sixfold that of good gunpowder.

But the disruptive or bursting power of gunpowder is not always the quality for which we value it most, nor the service we require of it. In mining rocks, in exploding shells, in blowing up fortresses, this property is what we value, and this work is what we require. But we do not want to burst our fowling-pieces, our rifles, our cannon. On the contrary, we want to use a force that shall project the projectile out of the gun without bursting the gun, without straining the gun beyond a given moderate limit, which it shall be able to endure. We want, therefore, a service from gun-cotton which shall be the contrary of destructive to, or disruptive of, the chamber in which it does the work of giving motion to the projectile.

This moderated and modified work, gun-cotton can also perform; and it is the modern discovery of General Lenk which has enabled us to moderate and modify gun-cotton to this gentler service. He discovered how to organise, arrange, and dispose mechanically of gun-cotton in such a way that it should be three times stronger than gunpowder. Accordingly one of his charges of gun-cotton, weighing 16 ounces, projected a 12-pound solid round shot with a speed of 1426 feet a second, while a charge of gunpowder of 49 ounces gave the same shot a speed of 1400 feet a second. One-third of the weight of gun-cotton exceeded, therefore, the threefold weight of gunpowder in useful effect.

II. Is gun-cotton more convenient than gunpowder? This is a larger and more various question than the former, and divides itself into various subdivisions.

It is well known to sportsmen, to soldiers, to artillerymen, that gunpowder fouls a gun. A foul residue of soot, sulphur, and potash soils the inside of the gun after every charge; the gun must, somehow, be cleaned after a discharge; if not it fires worse, recoils more, and ceases to do its best. If the gun be a breech-loading gun its mechanism is dirtied, and works less easily. Gun-cotton deposits no residue, leaves the gun clean and clear, and the utmost it does is to leave a gentle dew of clear water on the inside of the bore, this water being the condensed steam which forms one of the products of its decomposition. Gun-cotton is, therefore, superior to gunpowder in not fouling the gun, a result favourable both to quicker and more accurate firing.

It is further a matter of no slight convenience that gun-

* For the Chemical History of Gun-cotton, see Mr. Abel's discourse CHEMICAL NEWS, vol. ix., p. 254.

cotton makes no smoke. In mines the smoke of gunpowder makes the air unbreathable, and for some time after explosion the miners cannot return to their work. In boring the great tunnel of Mont Cenis through the Alps, the delay from smoke of powder alone will postpone the opening of the line for many months. After a properly-conducted explosion of gun-cotton the workmen may proceed in their work at once without inconvenience.

In casemates of fortresses gunpowder fills the casemates with foul smoke, and the men speedily sink under the exertion of quick firing. By using gun-cotton it was ascertained that the men could continue their work unharmed for double the quantity of firing. This is partly attributed to the greater heat, and partly to the foulness of the air produced by gunpowder.

But it is under the decks of our men-of-war that greatest benefit is likely to arise from gun-cotton. Not only does the smoke of a broadside fill the between decks with hot and foul air, but the smoke of the windward gun blinds the sight, and hinders the aim of the leeward. When there is no smoke, as with gun-cotton, the aim of every gun may be precise and deliberate. The diminished heat between decks will also tell powerfully in favour of gun-cotton. In our armour-plated ships also there is more value in breech-loading guns than in any other use of artillery. It is one of the necessities of breech-loading mechanism that it be kept clean, and nothing tends more to derange its perfect action than the greater heat which gunpowder imparts to the gun from which it is fired.

That gun-cotton has the convenience of not heating the gun has been thus proved. 100 rounds were fired in thirty-four minutes with gun-cotton, and the temperature of the gun was raised 90°. 100 rounds were fired with gunpowder, and triple the time allowed to cool the gun, which, nevertheless, was heated so much as to evaporate water with a hissing sound, which indicated that its temperature was much above 212°. Under these circumstances the firing with gunpowder had to be stopped, while that with gun-cotton was comfortably continued to 180 rounds.

It is also a matter of practical convenience that gun-cotton, insomuch as it is lighter, can be carried more easily and farther than gunpowder; and it may be wetted without danger, so that when dried again in the open air it is as good for use as before.

III. We have now to ask—is it cheaper? The answer to this question must be qualified—pound for pound it is dearer; we must, therefore, judge of its cheapness by its effect, not by weight merely. But where it does six times as much work, it can then be used at six times the price per pound, and still be as cheap as gunpowder. As far as we yet know, the prices of gun-cotton and gunpowder are nearly equal, and it is only, therefore, where the one has advantages and conveniences beyond the other, and is more especially suited for some specific purpose, that it will have the preference. Effective cheapness will, therefore, depend mainly on which of the two does best the particular kind of duty required of it.

To illustrate how curiously these two powers, gun-cotton and gunpowder, differ in their nature, and how the action of gun-cotton may be changed by mechanical arrangements, we may take one kind of work that is required of both:—If a general want to blow open the gates of a city, he orders an enterprising party to steal up to the gate, with a bag containing 100 lbs. of gunpowder, which he nails to the gate, and by a proper match-line he fires the gunpowder and bursts open the gate. If he nailed a bag of gun-cotton of equal weight in the same place and fired it, the gun-cotton would fail, and the gate would be uninjured, although the 100 lbs. of gun-cotton is sixfold more powerful than the gunpowder. Here, then, gunpowder has the advantage—both weight and effect considered.

But the fault here lies not in the gun-cotton, but the way of using it. If instead of 100 lbs. of gun-cotton in

a bag, 25 lbs. had been taken in a proper box made for this purpose, and simply laid down near the gate, and not even nailed to it, this 25 lbs. would shiver the gate into splinters. The bag which suits the powder happens not to suit the gun-cotton.

Gun-cotton is, therefore, a power of a totally different nature from gunpowder, and requires complete study to know its nature and understand its use. It appears that both gunpowder and gun-cotton have special qualities, and may be peculiarly suited for peculiar uses. It is the duty of a wise people to make use of both to the ends they each suit best, without prejudice arising from the accident of novelty or antiquity.

The nature of gun-cotton requires a double study, chemical and mechanical. It is not like steam, the same substance, whether in the form of ice or water or steam. It is one substance when, as gun-cotton, it enters the gun, and quite a different one when it has exploded and leaves the gun. Not only are the solids which enter converted into gas, but they form totally new combinations and substances. So that the marvellous changes which the chemist effects by the magic of his art take place in an instant of time, and during that almost inconceivably minute period of time, in a laboratory intensely heated, old substances are dissolved, their material atoms are redistributed, each atom released selects by natural affinity a new partner, these new unions are cemented, and at the end of this prolific instant totally new combinations of matter, forming what we call new substances, issue from the gun. It so happens that of these new substances, formed out of gun-cotton, all are pure transparent gases, while in the case of gunpowder there remain 68 per cent. of solid residue, and only 32 per cent. are pure gases.

Mechanical Applications of Gun-cotton.

The mechanical application of gun-cotton may be considered to be due exclusively to Major-General Lenk, of the Austrian service. Pure gun-cotton becomes either a powerful explosive agent, or a docile performer of mechanical duty, not according to any change in its composition, or variation in its elements or their proportions, but according to the mechanical structure which is given to it, or the mechanical arrangements of which it is made a part. It was General Lenk who discovered that structure was quality, and mechanical arrangement the measure of power, in gun-cotton; and in his hands, a given quantity of the same cotton becomes a mild, harmless, ineffectual firework, a terrible, irresistible, explosive agent, or a pliable, powerful, obedient workman.

The first form which General Lenk bestowed on gun-cotton was that of a continuous yarn or spun thread. Gunpowder is carefully made into round grains of a specific size. Gun-cotton is simply a long thread of cotton fibre, systematically spun into a yarn of given weight per yard, of given tension, of given specific weight. A hank of a given length is reeled, just like a hank of cotton yarn to be made into cloth, and in this state gun-cotton yarn is bought and sold like any other article of commerce.

This cotton yarn converted into gun-cotton may be called, therefore, the raw material of commerce. In this form it is not at all explosive in the common sense of the word. You may set fire to a hank of it, and it will burn rapidly with a large flame; but if you yourself keep out of reach of the flame, and keep other combustibles beyond reach, no harm will happen, and no explosion or concussion will result. If you lay a long thread of it round your garden walk at night, disposing it in a waving line with large balls of gun-cotton thread at intervals, and light one end of the thread, it will form a beautiful firework, the slow lambent flame creeping along with a will-o'-th'-wisp-looking light, only with a measured speed of six inches per second, or thirty feet a minute, the wind hastening it or retarding it as it blows with or against the line of the

thread. This is the best way to commence an acquaintance with this interesting agent.

Care must be taken not to become too familiar with gun-cotton even in this harmless and playful guise. Cotton dresses will readily catch fire from it, and it should not be treated with less care to keep fire from it than gunpowder. In one respect it is less liable to cause danger than gunpowder. Grains of powder are easily dropped through a crevice, and may be sprinkled about in a scarcely noticeable form, but a hank of gun-cotton is a unit, which hangs together and cannot strew itself about by accident.

The *second* form of gun cotton is an arrangement compounded out of the elementary yarn. It resembles the plaited cover of a riding whip; it is plaited round a core or centre which is hollow. In this form it is match-line, and although formed merely of the yarn plaited into a round hollow cord, this mechanical arrangement has at once conferred on it the quality of speed. Instead of travelling as before only six inches a second, it now travels six feet a second.

The *third* step in mechanical arrangement is to enclose this cord in a close outer skin or coating, made generally of india-rubber cloth, and in this state it forms a kind of match-line, that will carry fire at a speed of from twenty to thirty feet per second.

It is not easy to gather from these changes what is the cause which so completely changes the nature of the raw cotton by mechanical arrangement alone. Why a straight cotton thread should burn with a slow creeping motion when laid out straight, and with a rapid one when wound round in a cord, and again much faster when closed in from the air, is far from obvious at first sight; but the facts being so, deserve mature consideration.

The cartridge of a common rifle in gun-cotton is nothing more than a piece of match-line in the second form enclosed in a stout paper tube, to prevent it being rammed down like powder. The ramming down which is essential to the sensitive action of gunpowder is fatal to that of gun-cotton. To get useful work out of a gun-cotton rifle, the shot must on no account be rammed down, but simply transferred to its place. Air left in a gunpowder barrel is often supposed to burst the gun; in a gun-cotton barrel it only mitigates the effect of the charge. The object of enclosing the gun-cotton charge in a hard strong paste-board cartridge is to keep the cotton from compression and give it room to do its work.

It is a *fourth* discovery of General Lenk, that to enable gun-cotton to perform its work in artillery practice, the one thing to be done is to "give it room." Don't press it together—don't cram it into small bulk; give it at least as much room as gunpowder in the gun, even though there be only one-third or one-fourth of the quantity (measured by weight). One pound of gun-cotton will carry a shot as far as three or four pounds of gunpowder, but that pound should have at least a space of 160 cubic inches in which to work.

This law rules the practical application of gun-cotton to artillery. A cartridge must not be compact; it must be spread out or expanded to the full room it requires. For this purpose a hollow space is preserved in the centre of the cartridge by some means or other. The best means is to use a hollow thin wooden tube to form a core. This tube should be as long as to leave a sufficient space behind the shot for the gun-cotton. On this long core the simple cotton yarn is wound round like thread on a bobbin, and sufficiently thick to fill the chamber of the gun; indeed, a lady's bobbin of cotton thread is the innocent type of the most destructive power of modern times—only the wood in the bobbin must be small in quantity in proportion to the gun-cotton in the charge. There is no other precaution requisite except to enclose the whole in the usual flannel bag.

The artillerist who uses gun-cotton has, therefore, a tolerably simple task to perform if he merely wants gun-

cotton to do the duty of gunpowder. He has only to occupy the same space as the gunpowder with $\frac{1}{4}$ th of the weight of gun-cotton made up in the bobbin as described, and he will fire the same shot at the same speed. This is speaking in a general way, for it may require in some guns as much as $\frac{1}{3}$ rd of the weight of gunpowder and $\frac{11}{10}$ ths the bulk of charge to do the same work; a little experience will settle the exact point, and greater experience may enable the gun-cotton to exceed the performance of the gunpowder in every way.

The *fifth principle* in the use of gun-cotton is that involved in its application to bursting uses. The miner wants the stratum of coal torn from its bed or the fragment of ore riven from its lair; the civil engineer wishes to remove a mountain of stone out of the way of a locomotive engine; and the military engineer to drive his way into the fortress of an enemy, or to destroy the obstacles purposely laid in his way. This is a new phase of duty for gun-cotton—it is the work of direct destruction. In artillery you do not want to destroy directly, but indirectly. You don't want to burst your gun, nor even to injure it; and, we have seen, in order to secure this, you have only to give it room.

The fifth principle, therefore, is, to make it destructive—to cause it to shatter everything to pieces which it touches, and for this purpose you have only to deprive it of room. Give it room, and it is obedient; imprison it, and it rebels. Shut up without room, there is nothing tough enough or strong enough to stand against it.

To carry this into effect, the densest kind of gun-cotton must be used. It must no longer consist of fine threads or hollow textures wound on roomy cores. All you have to do is to make it dense, solid, hard. Twist it, squeeze it, ram it, compress it; and insert this hard, dense cotton rope or cylinder or cake in a hole in a rock, or the drift of a tunnel, or the bore of a mine; close it up, and it will shatter it to pieces. In a recent experiment six ounces of this material set to work in a tunnel not only brought down masses which powder had failed to work, but shook the ground under the feet of the engineers in a way never done by the heaviest charges of powder.

To make gun-cotton formidable and destructive squeeze it and close it up; to make it gentle, slow, and manageable, ease it and give it room. To make gunpowder slow and gentle, you do just the contrary: you cake, condense, and harden it to make it slow, safe for guns, and effective.

To carry out this principle successfully, you have to carry it even to the extreme. Ask gun-cotton to separate a rock already half-separated, it will refuse to comply with your request. Give it a light burden of earth and open rock to lift, it will fail. If you want it to do the work, you must invent a *ruse*,—you must make believe that the work is hard, and it will be done. Invent a difficulty and put it between the cotton and its too easy work, and it will do it. The device is amazingly successful. If the cotton have work to do that is light and easy, you provide it with a strong box, which is hard to burst,—a box of iron, for example; close a small charge, that would be harmless, in a little iron box, and then place that box in the hole where formerly the charge exploded harmless, and in the effort it makes to burst that box, the whole of the light work will disappear before it.

The first trial of English-made gun-cotton was made at Stowmarket in the spring of 1861. A charge of twenty-five pounds not only destroyed a tree-stockade, but shattered it into matchwood.

It is, therefore, the nature of gun-cotton to rise to the occasion and to exert force exactly in proportion to the obstacle it encounters. For destructive shells this quality is of the highest value. You can make your shell so strong that nothing can resist its entrance, and when arrived at its destination no shell can prevent its gun-cotton charge from shivering it to fragments.

These are the main principles in the mechanical manipu-

lation of gun-cotton which will probably render it for the future so formidable an instrument of war. Resistances too great for gunpowder only suffice to elicit the powers of gun-cotton. On the other hand, in its elementary state, as the open cotton-yarn, it is playful, slow, gentle, and obedient; there is scarcely any mechanical drudgery you can require of it that it is not as ready and fit to do as steam, or gas, or water, or other elementary power.

In conclusion, I may be asked to say as a mechanic what I think can be the nature and source of this amazing power of gun-cotton. In reply, let me ask, Who shall say what takes place in that pregnant instant of time when a spark of fire enters the charge, and one-hundredth part of a second of time suffices to set millions of material atoms loose from fast ties of former affinity, and leaves them free every one to elect his mate, and uniting in a new bond of affinity, to come out of that chamber a series of new-born substances? Who shall tell me all that happens then? I will not dare to describe the phenomena of that pregnant instant. But I will say this, that it is an instant of intense heat—one of its new-born children is a large volume of steam and water. When that intense heat and that red-hot steam were united in the chamber of that gun and that mine two powers were met whose union no matter yet contrived has been strong enough to compress and confine. When I say that a gun-cotton gun is a steam gun, and when I say that at that instant of intense heat the atoms of water and the atoms of fire are in contact atom to atom, it is hard to believe that it should not give rise to an explosion infinitely stronger than any case of the generation of steam by filtering the heat leisurely through the metal skins of any high-pressure boiler.

ACADEMY OF SCIENCES.

August 17.

FATHER SECCHI continues his observations "*On the Spectra of the Planets*," giving on this occasion a more particular account of that of Jupiter. The present communication confirms the existence of special atmospheric lines, which do not exactly accord with our own. The line C is absolutely wanting in Jupiter, and the position of others is different. The author believes in the existence of the solar lines in the spectrum of the planet, but states that its atmosphere has a stronger absorbing power than our own.

M. Chatin has made a most extensive series of researches. "*On the Proportion of Sugar contained in the Sap and the Vegetable Juices generally*." But little can be gathered from this communication beyond the fact that the amount of sugar differs greatly in different plants, which was well known before. He estimated the sugar by the fermentation test.

For those interested in the subject, we may state that the Abbé Chevallier describes a great find of flint implements near Grand-Pressigny (Indre et Loire). The tools are here found not in single specimens, but in thousands. Two explorers brought to the author some hundreds of kilogrammes of the instruments gathered in a few hours.

M. Renault communicated an interesting "*Contribution to the History of Protochloride of Copper*." A plate of copper dipped in a solution of bichloride of copper, perchloride of iron, dilute *aqua regia*, or any solution which parts easily with chlorine, becomes covered with a greyish white layer of cuprous chloride which is remarkable for its sensibility to light. A negative placed on a plate so sensitivised gives a positive picture of great beauty. We shall return to this paper.

M. E. Kopp described "*A Process for Obtaining Yellow Alizarine from the Green Alizarine of Commerce*." The author simply boils it repeatedly with schist oil, which dissolves the yellow and leaves the green, part of the former depositing in the crystalline state as the oil cools. The oil is then shaken with weak caustic soda, which removes the part remaining in solution. The soda solution

is afterwards separated from the oil and treated with sulphuric acid, which immediately precipitates the yellow alizarine, now only requiring to be washed and dried.

The blackish-green matter left by the oil in the first operation when treated with diluted nitric acid yields a yellow colouring matter soluble in alkaline liquors, and slightly soluble in water, to which the author has given the name *xanthazarine*, and which dyes wool and silk, mordanted or not, much the same colour as yellow wood. Reducing agents convert this xanthazarine into a new red colouring matter.

M. Caron returns to the question of the "*Clementation of Iron by Carbonic Oxide*." He believes that in the operation carried out on a commercial scale at a red heat carbonic oxide cannot be regarded as an useful agent, but he details some experiments which show that under conditions it is possible by means of it to charge iron with as much carbon as one may wish. He took a gramme of pure oxide, reduced it by means of hydrogen, the iron obtained weighing 0.7 of a gramme, and after exposing this to carbonic oxide at a low temperature (not high enough to soften glass) for six hours the matter obtained weighed 3.170 grammes. At a red heat he states that practically no absorption of carbon takes place. This paper is a reply to that of M. Margueritte, which we noticed a week or two ago.

M.M. Leplay and Taillard have injected the spores of *Penicillium glaucum* and the *Oidium Tuckeri* into the veins of dogs, but nothing came of it. Our medical readers will remember that *Penicillium glaucum*, it has been said, will cause psoriasis, and the *oidium phlegmonous* inflammations and other discomforts. The authors of this paper, however, could produce none of these disorders.

NOTICES OF BOOKS.

International Exhibition. Report on Class II. Section A. Industry of Manures.

TRACING the history of the manufacture of artificial manures since 1840, the Reporter first comes to the patent of Mr. Lawes for the manufacture of superphosphate of lime (1842), and it is very properly pointed out that it was Liebig who first suggested the employment of this material as a manure. Mr. Lawes afterwards disclaimed the use of all but mineral phosphates, and made other alterations which look like an admission of his source of inspiration. Subsequently (1845) Liebig himself patented a manure in this country; but in this makes use of calcined bones. These, he states in his work on "*Artificial Manures*," act "sufficiently quickly in the soil, being deprived of the gelatine, which diminishes the solubility of raw bones in soils rich in organic matter."

It must be confessed that there is a strong resemblance between these two celebrated patents, and probably curious questions would have been raised by chemists if either had been disputed in a court of law. The patents, however, are now only matters of history; but the trade in superphosphate of lime is larger than ever, and Mr. Lawes favours the Reporter with the following particulars as to the most improved method of manufacturing the article, with its average composition and price:—

"The phosphatic materials are first ground to a very fine powder by mill-stones; the powder is then carried up by means of elevators, and discharged continuously into a long iron cylinder, having agitators revolving within it with great velocity. A constant stream of sulphuric acid, of sp. gr. 1.66, enters the cylinder at the same end as the dry powder, and the mixture flows out at the other end in the form of a thick mud, having taken three to five minutes in passing through the machine. The quantity turned out by such a mixing-machine is about 100 tons daily. The semi-fluid mass runs into covered pits 10 to 12 feet deep, each of sufficient size to hold the produce of the

day's work. It becomes tolerably solid in a few hours, but retains a high temperature for weeks, and even months, if left undisturbed.

"The composition of a superphosphate of good quality, made partly from mineral phosphate and partly from ordinary bones, may be stated as follows:—

Soluble phosphate	.	.	22 to 25	per cent.
Insoluble phosphate	.	.	8 „ 10	„
Water	.	.	10 „ 12	„
Sulphate of lime	.	.	35 „ 45	„
Organic matter	.	.	12 „ 15	„
Nitrogen, 0.75 to 1.5 per cent.				

"If sufficient sulphuric acid were used to decompose the whole of the phosphate of lime, the product would be too wet to be packed in bags, and would require either to be mixed with extraneous substances of a dry and porous nature, or to be artificially dried.

"The price of the best descriptions of superphosphate ranges from 5*l.* 15*s.* to 6*l.* 10*s.* per ton, and of that made from purely mineral phosphate from 4*l.* to 5*l.* 5*s.* per ton."

Some idea of the extent of the trade in this article may be gathered from the statement that Mr. Lawes himself produces 18,000 to 20,000 tons of superphosphate annually; and the total yearly production of superphosphate in Great Britain is estimated by him as ranging from 150,000 to 200,000 tons.

Of the raw materials annually worked up into superphosphate in Great Britain, Mr. Lawes estimates that about half is derived from the deposits of fossil bone-earth, or coprolite, discovered of late years in several parts of England. Bone-ash, chiefly imported from South America, animal charcoal from Germany, and bones from all parts of the world, together supply about 40 per cent. more of the raw material; while the remaining 10 per cent. of the total supply is made up by guano (chiefly of the less nitrogenous and more phosphatic kinds), with a little apatite (say 200 to 500 tons per annum) obtained from Spain, Norway, and America.

The Reporter next comes to imported manures, and naturally commences with Peruvian guano, which appears to have been first imported about the year 1838, and sold for 20*l.* a ton. In 1841 it had been tried on sixty farms, and the importations soon largely increased. In 1842 only 182 tons were imported, but in the following year the importations reached 4667 tons, and in 1862 they amounted to the enormous quantity of 435,000 tons. Of this vast total, it is said that from a fourth to a third is retained for use in the United Kingdom.

When speaking of the price of Peruvian guano, we are somewhat surprised to see that the Reporter has nothing to say against the monopoly of this article which is maintained, and which to some extent influences the price of all manufactured manures.

In a section on the "good and evil of the trade in manures," the author seems to adopt the narrow views of Liebig on the subject of the exportation of fertilising agents. We quote the passage at length, since it exhibits the ideas of Liebig in a very strong light, and also to some extent refutes them:—

"The manure trade (he says) presents itself in two aspects; the one advantageous, the other detrimental to mankind. Nothing can be more advantageous than the collection and utilisation of fertilising residua formerly cast away as worthless. The fossil phosphates quarried out of the bosom of the earth, and the guano extracted (by the successive intervention of seaweeds, fishes, and penguins) from the depths of the ocean, are evidently so much treasure fairly won from Nature for the legitimate enrichment of mankind. Even the withdrawal of recent bones and bone ash, from plains untenanted as yet save by wild cattle, to fertilise the cornfields of the populous old world, must be accounted a legitimate commerce. But the boundary line is overpassed, and the manure trade becomes abnormal, when

bones are withdrawn from one populous country to enrich the exhausted fields of another.

"Nor is the detriment thus occasioned confined to the country whose soil is impoverished. In the closely-knit relations of modern commerce, the impoverishment of any one commercial country reacts on the prosperity of all the others, by diminishing the stock of exchangeable wealth in the world. If Germany, for instance, grows less corn, her purchasing power for foreign goods, say French or British, is proportionately diminished, and commerce suffers *pro tanto*. The gain to France or England is, therefore, but illusory, if either robs a neighbour's soil to fertilise her own.

"In a work just published,* Baron Liebig sternly rebukes England for her over-eagerness to buy up, in the form of bones, the phosphatic wealth of countries less advanced than herself in financial and industrial power, and for the apparent recklessness with which she squanders forth these treasures (ill-gotten and ill-spent) down her innumerable sewers to the sea. The great agricultural teacher manifests alarm at the superabundant zeal with which the most diligent of his pupils obeys his lessons; and to other nations he earnestly points out the ruinous consequences that must ensue to them, from the exportation of phosphates, drawn from their soil, to stay the exhaustion of the English fields. His cry of warning is couched in terms of almost passionate invective:—

"England (he exclaims) is robbing all other countries of the conditions of their fertility. Already, in her eagerness for bones, she has turned up the battle-fields of Leipzig, Waterloo, and of the Crimea; already from the catacombs of Sicily she has carried away the skeletons of many successive generations. Annually she removes from the shores of other countries to her own, the manurial equivalent of three millions and a-half of men; whom she takes from us the means of supporting, and squanders down her sewers to the sea. Like a vampire she hangs upon the neck of Europe, nay, of the entire world, and sucks the heartblood from nations, without a thought of justice towards them, without a shadow of lasting advantage for herself.

"It is impossible (he proceeds to say) that such iniquitous interference with the Divine order of the world should escape its rightful punishment; and this may, perhaps, overtake England even sooner than the countries she robs. Most assuredly a time awaits her, when all her riches of gold, iron, and coal will be inadequate to buy back a thousandth part of the conditions of life, which for centuries she has wantonly squandered away."

Doubtless it is very sinful in us to waste our natural manure in the way we do, and one day we shall be obliged to seriously consider the subject. In the meantime, if we did not buy manure we should have to buy more food from foreign countries; but nobody argues that a country is impoverished by exporting its surplus food. How then can it be by exporting its surplus manure? But already it seems that if we *have* robbed Germany of its bones, we now export to it our coprolites, and thus, as the Reporter says, "the balance of trade seems to be arriving at a just equilibrium in the matter, as indeed it always does, if only it be left to swing freely."

The next section, entitled "Modern Historical Events connected with the Development of Manurial Industry," is a remarkable one.

(To be continued.)

A Dictionary of Chemistry, &c. By HENRY WATTS, B.A., F.C.S. Part XVIII. London: Longman and Co. 1864.

THE present part includes the articles from Iron to Lacturarium, and the student will find in it two valuable essays on Isomerism and Isomorphism, which will well repay attentive perusal.

* 'Einleitung in die Naturgesetze des Feldbaues.' Von Justus von Liebig. Braunschweig: Vieweg und Sohn, 1863.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Notices to Proceed.

856. Edward Thomas Hughes, Chancery Lane, London, "An improved controlling apparatus for registering the quantity and quality of alcohol obtained in distilleries."—A communication from Traugott Glaeser, Brieg, and Ernst Hofmann, Breslau, Prussia.—Petition recorded April 6, 1864.

877. John Picking, Spitalfields, "Improvements in refrigerators or apparatus for refrigerating or cooling wort and other liquids."

887. William Clark, Chancery Lane, Middlesex, "Improvements in preparing or treating vegetable fibrous materials."—A communication from Hubert Dupré, Boulevard St. Martin, Paris.—Petitions recorded April 8, 1864.

893. John Hawkins Simpson, Kilmeena, Ireland, "Certain improvements in printing from type by electricity."—Petition recorded April 9, 1864.

953. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in metallic capsules."—A communication from William Betts, Bordeaux, France.—Petition recorded April 15, 1864.

959. William Clark, Chancery Lane, Middlesex, "Improvements in the preservation of animal matters."—A communication from Jean Pierre Lies Bodart, Boulevard St. Martin, Paris.

965. Alfred Vincent Newton, Chancery Lane, Middlesex, "An improved mode of manufacturing cerealine."—A communication from James Brown, Philadelphia, U.S.A.—Petitions recorded April 16, 1864.

1125. Thomas Henry Rees, Hatcham, Surrey, "Improvements in blue colouring matters for washing purposes, and in receptacles for containing the same ready for use."—Petition recorded May 4, 1864.

1161. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improved apparatus for facilitating the inhalation of medicinal substances."—A communication from John Jones, New York, U.S.A.—Petition recorded, May 7, 1864.

1196. Thomas Matthew Gisborne, Lymington, Southampton, "Improvements in kilns for burning bricks, tiles, and other earthenware or ceramic articles, limestone, and ores."—Petition recorded May 11, 1864.

1642. Thomas Nichols, New York, U.S.A., "Improvements in the preservation of eggs, and in apparatus to be used in connection therewith."—Petition recorded July 1, 1864.

1706. Thomas Sharp, Nashville, Tennessee, North America, "Certain improvements in tanning hides and in the apparatus employed therein."—Petition recorded July 9, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, August 20.

THE members of M. Leverrier's excellent Astronomical Society have had quite a gala week of it examining M. Tempel's comet with the large refractor belonging to them at the Observatory. The poor comet has had a great deal to bear in the way of abuse. M. Z. says he brought the hot weather; M. Y. says he is not bright enough; M. X. insinuates that he is keeping away the rain; and M. W. insults the poor fellow by mocking at his want of a tail. No wonder at his stopping so short a time. However, M. Donati announces the discovery of another amongst the tresses of Berenice's hair.

The first gratuitous course of twenty-five lectures on Chemistry at the Museum of Natural History has been attended by over fifty pupils, mostly from the schools of

medicine and pharmacy. When I tell you that the lectures are by MM. Chevreul, Fremy, and E. Becquerel, you will not wonder at the success they have met with.

Those who have known and felt the great influence exercised in cheapening good French literature of every description by M. Hachette will regret to hear of his death. He was followed to his grave by a large crowd of literary notabilities. He was greatly beloved and respected by his contemporaries, and was the John Murray of this side of the Channel.

Our friend the *Cosmos* has just discovered a new county in England, but forgets to tell us whether it is east, west, north, or south. In announcing the purchase of a very perfect specimen of the plesiosaurus by the British Museum, your contemporary states that it was discovered "*sur la côte du TORSETZIR*"! After referring to numerous gazetteers on the subject, and diligently examining the maps of Poland, Hungary, and Bohemia, a facetious English friend suggests that Dorsetshire is meant, but I have rejected his hypothesis as absurd.

Still another economical nitrate of silver bath for positive prints! It is the invention of M. Grüner, a Berlin photographer. Nitrate of lead, 12.5 parts; nitrate of silver, 5 parts; water, 100 parts. The paper being floated and dried as usual is passed through a bath of solution of potash containing 35 per cent. of alkali, which turns it to a yellowish brown. The paper is then dried, printed, toned, and fixed in the usual manner.

M. Georges Ville has been down at his experimental farm at Belle Eau, in the Department of the Drome, lecturing to the farmers of that locality. Artificial manure appears to have been the subject of his lectures, his object being to demonstrate that artificial manure made on correct principles was better than any other. He showed them several fields of corn treated with different artificial and natural manures, and some without any manure at all, and proved to them incontestably that the field fertilised with an artificial manure containing the proper admixture of phosphates, lime, potash, nitrogen, &c., produced the best results. Of those present many were cocks who did not like to leave the dunghills they had been accustomed to *ab ovo*, and who protested against any such innovations; but M. Ville answered all their objections, and, let us hope, convinced them of the fallacy of their old-world notions. The farm at Belle Eau, like that at Vincennes, has been placed at the disposal of M. Ville by the Emperor.

A M. Martin, of Jersey, has seriously announced to the Academy of Sciences (which has received this announcement with great gravity) that a cat of that town had recently given birth to a young one half-cat half-dog! This reminds one of the celebrated hybrid half-fowl half-rabbit that so nearly deceived one of your most popular naturalists. Surely our Academy, like your *Times*, has its "silly season."

MISCELLANEOUS.

Cavendish Society.—We may announce that the sixteenth volume of Gmelin's "Chemistry" is now being issued to the subscribers for 1862. It brings the work down as far as bodies containing 34 atoms of carbon, and it is said that one more volume will complete the work.

University of London.—First B.Sc. Examination, 1864.—The following gentlemen took honours in Chemistry and Natural Philosophy:—

First Class.

Wright, C. R. A. (Exhibition), Owen's College.
Brown, J. C., University of Aberdeen & School of Mines.

Third Class.

Exall, William Henry, King's College.
Graham, Charles, University College.
Kisch, Albert, St. Thomas's and London Hospitals.

Death of Dr. R. Dundas Thompson.—Dr. Robert Dundas Thompson died on Wednesday last at Dunstable. He was in the 60th year of his age. His first degrees were taken in Glasgow, in which university he afterwards held the chair of chemistry, but in 1859 became a member of the Royal College of Physicians. He filled the chair of chemistry at St. Thomas's Hospital for many sessions, was physician to the Scottish Hospital and to the Blenheim Free Dispensary, of which he was one of the founders. He was a fellow of the Royal Society, and of the London, Edinburgh, Royal Medical, and the Chirurgical, and Chemical Societies, and president of the British Meteorological Society. He also occupied the position of medical officer of health to the borough of Marylebone.

Lingard (Administratrix) v. Clay and Abraham.—This was an action tried before Mr. Baron Pigott at the Liverpool Assizes. The action was brought under Lord Campbell's Act for the loss of a husband, the damages claimed being 3000*l.* The late Mr. Lingard met his death owing to an unfortunate mistake by Richard Poole, an assistant in the establishment of Messrs. Clay and Abraham, chemists, Liverpool. A number of physicians and chemists attended to show that the mode of keeping the poisons in Messrs. Clay and Abraham's establishment was the common and most approved mode. It was announced, however, that the parties had agreed to a verdict of 1500*l.* 15*s.*, which was apportioned thus:—One shilling to the eldest child, who inherits upon his father's death, 500*l.* to the widow, and 500*l.* to each of the other children.

Mineral Statistics for 1863.—The following tables place the whole question of the value of our mining operations at once before the eye:—

General Summary, of which Returns are given, for 1863.

Minerals.	Quantity.	Value.
Gold quartz, tons	385	£1,500
Tin ore, tons	15,157	963,985
Copper ore, tons	210,947	1,100,554
Lead ore, tons	91,283	1,193,530
Silver ore, tons	88	5,703
Zinc ore, tons	12,941	29,968
Iron ore, tons	9,101,552	3,240,890
Pyrites, tons	95,376	62,035
Wolfram, tons	13	67
Uranium, cwts.	3	23
Gossans, tons	4,424	4,576
Arsenic, tons	1,444	1,200
Coals (sold and used), tons	86,292,215	20,572,945
Earthy minerals, estimated at	—	1,975,000

Total value of the minerals produced in 1863 £29,151,376

Metals produced from British Minerals and Coals.

	Quantity.	Value.
Gold, ozs.	552	£1,747
Tin, tons	10,006	1,170,702
Copper, tons	14,247	1,409,608
Lead, tons	68,220	1,418,985
Silver, ozs.	634,004	174,351
Zinc, tons	3,835	90,889
Iron (pig), tons	4,510,040	11,275,100

Total value of the above 15,541,382

Estimated value of other metals 250,000

Coals 20,572,945

Total value of the metals obtained and coals produced in 1863 £36,364,327

Poisoning by Calabar Beans.—There is no doubt that the poisoning at Liverpool, mentioned last week, resulted from eating Calabar beans. Dr. Edwards has been kind enough to forward us some of those found in the rubbish. It seems extraordinary that an article fetching so high a price should be disposed in such a careless way. The following is the chemical evidence given

by Dr. Edwards, at the inquest on Michael Russell, who died from the effects of the poison:—John Baker Edwards deposed: I am an analytical chemist, and lecturer on medical jurisprudence, at the Royal Infirmary School of Medicine, Liverpool. On Friday, the 12th instant, I attended a *post-mortem* examination of the remains of the deceased Michael Russell, and removed the stomach, intestines, and parts of the viscera of deceased in jars, which I conveyed to my laboratory at the Royal Institution, for chemical examination. On the same day I received from Inspector Moore a parcel of beans, said to be similar to those of which the said Michael Russell had eaten. The beans are those known in medicine as Calabar ordeal beans (*Physostigma venenosum*). I proceeded to make an alcoholic extract of the beans, also of the contents of deceased's stomach and of the contents of deceased's intestines. The stomach contained only five fluid ounces of fluid, consisting of a few fragments of the bean, and the remains of a mustard emulsion which had been administered shortly before death. The quantity of alcoholic extract from the stomach was therefore very small, and its reactions were obscured by the mustard. After further purification by ether, an extract was obtained which caused marked contraction of the pupil in the eye of a rabbit when applied to it externally. From the intestines of deceased I obtained 17 fluid ounces of an emulsive fluid, which, after digestion with the alcohol, yielded an extract, which was then purified by ether and evaporated. This ethereal extract corresponded in its reactions with a similarly prepared extract of the beans under examination. The chemical reactions on a watery solution of the ethereal extract are as follows:—1. A pink colour, struck by caustic potash, which gradually increases in intensity to a deep red, and when mixed with chloroform forms a deep red chloroformic solution, which separates from the clear yellowish supernatant liquor. 2. A red colour, struck by strong sulphuric acid, with separation of a resinoid coagulum. 3. A violet colour, changing to red by sulphuric acid and crystals of bichromate of potash. 4. A similar colour, with sulphuric acid and binoxide of manganese, retaining the purple colour for a long time. 5. A yellow precipitate, with solution of iodine in iodide of potassium. 6. A purple colour, with tri-chloride of gold and reduction of metallic gold. 7. A yellow colour, struck with caustic ammonia, which, exposed for some hours to light, turned green, and finally a deep blue. I applied a few drops of the aqueous emulsion of this ethereal extract obtained from the intestines of deceased to a frog's back, by insertion under the skin. In a short time the animal manifested an indisposition to movement, and became very quiet. In the course of an hour it became unable to jump, or to remove the position in which its limbs were placed, and in about two hours it became perfectly flaccid and insensible to any external irritation; although stimulated by strychnine, it was incapable of being roused to muscular exertion, and soon expired, having previously exhibited very irregular respiration and pulsation. A second portion of the emulsion was exhibited to a mouse, which became soon paralysed in its limbs, and died after a few hours. A third portion was introduced into the circulation of a mouse by the ear, and after twenty-four hours the poison operated fatally, by complete paralysis of the limbs and senses, and the animal died by syncope. A fourth portion of the emulsion from the intestines of deceased applied to the eye of a rabbit caused strong contraction of the pupil after three-quarters of an hour. Similar results were obtained by an ethereal extract of the bean itself.

ANSWERS TO CORRESPONDENTS.

Erratum.—Page 89, col. 2, five lines from bottom, for *divides* read *doubles*.

M. X.—Abstracts of the Friday evening lectures alone are published.

G. L.—We do not believe there is a patent.

Received.—R. S.; Dr. Adriani; Dr. Edwards, with thanks.

SCIENTIFIC AND ANALYTICAL
CHEMISTRY.

On the Properties of Silicic Acid and other analogous
Colloidal Substances,* by THOMAS GRAHAM, F.R.S.

(PRELIMINARY NOTICE.)

(Continued from page 99.)

The production of the compounds of silicic acid now described indicates the possession of a wider range of affinity by a colloid than could well be anticipated. The organic colloids are no doubt invested with similar wide powers of combination, which may become of interest to the physiologist. The capacity of a mass of gelatinous silicic acid to assume alcohol, or even oleine, in the place of water of combination, without disintegration or alteration of form, may perhaps afford a clue to the penetration of the albuminous matter of membrane by fatty and other insoluble bodies, which seems to occur in the digestion of food. Still more remarkable and suggestive are the *fluid* compounds of silicic acid. The fluid alcohol-compound favours the possibility of the existence of a compound of the colloid albumen with oleine, soluble also and capable of circulating with the blood.

The feebleness of the force which holds together two substances belonging to different physical classes, one being a colloid and the other a crystalloid, is a subject deserving notice. When such a compound is placed in a fluid the superior diffusive energy of the crystalloid may cause its separation from the colloid. Thus, of hydrated silicic acid, the combined water (a crystalloid) leaves the acid (a colloid) to diffuse into alcohol; and if the alcohol be repeatedly changed the entire water is thus removed, alcohol (another crystalloid) at the same time taking the place of water in combination with the silicic acid. The liquid in excess (here the alcohol) gains entire possession of the silicic acid. The process is reversed if an alcogel be placed in a considerable volume of water. Then alcohol separates from combination, in consequence of the opportunity it possesses to diffuse into water; and water, which is now the liquid present in excess, recovers possession of the silicic acid. Such changes illustrate the predominating influence of mass.

Even the compounds of silicic acid with alkalies yield to the decomposing force of diffusion. The compound of silicic acid with 1 or 2 per cent. of soda is a colloidal solution, and, when placed in a dialyser over water *in vacuo* to exclude carbonic acid, suffers gradual decomposition. The soda diffuses off slowly in the caustic state, and gives the usual brown oxide of silver when tested with the nitrate of that base.

The peptisation of liquid silicic acid and many other liquid colloids is effected by contact with minute quantities of salts in a way which is not understood. On the other hand, the gelatinous acid may again be liquefied and have its energy restored by contact with a very moderate amount of alkali. The latter change is gradual, one part of caustic soda, dissolved in 10,000 water, liquefying 200 parts of silicic acid (estimated dry) in 60 minutes at 100° C. Gelatinous stannic acid also is easily liquefied by a small proportion of alkali, even at the ordinary temperature. The alkali, too, after liquefying the gelatinous colloid, may be separated again from it by diffusion into water upon a dialyser. The solution of these colloids, in such circumstances, may be looked

upon as analogous to the solution of insoluble organic colloids witnessed in animal digestion, with the difference that the solvent fluid here is not acid but alkaline. Liquid silicic acid may be represented as the "peptone" of gelatinous silicic acid; and the liquefaction of the latter by a trace of alkali may be spoken of as the peptisation of the jelly. The pure jellies of alumina, peroxide of iron, and titanitic acid, prepared by dialysis, are assimilated more closely to albumen, being peptised by minute quantities of hydrochloric acid.

Liquid Stannic and Metastannic Acids.—Liquid stannic acid is prepared by dialysing the bichloride of tin with an addition of alkali, or by dialysing the stannate of soda with an addition of hydrochloric acid. In both cases a jelly is first formed on the dialyser; but as the salts diffuse away the jelly is again peptised by the small proportion of free alkali remaining; the alkali itself may be removed by continued diffusion, a drop or two of the tincture of iodine facilitating the separation. The liquid stannic acid is converted on heating into liquid metastannic acid. Both liquid acids are remarkable for the facility with which they are peptised by a minute addition of hydrochloric acid as well as by salts.

Liquid Titanitic Acid is prepared by dissolving gelatinous titanitic acid in a small quantity of hydrochloric acid without heat, and placing the liquid upon a dialyser for several days. The liquid must not contain more than 1 per cent. of titanitic acid, otherwise it spontaneously gelatinises, but it appears more stable when dilute. Both titanitic and the two stannic acids afford the same classes of compounds with alcohol, &c., as are obtained with silicic acid.

Liquid Tungstic Acid.—The obscurity which has so long hung over tungstic acid is removed by a dialytic examination. It is, in fact, a remarkable colloid, of which the pectous form alone has hitherto been known. Liquid tungstic acid is prepared by adding dilute hydrochloric acid carefully to a 5 per cent. solution of tungstate of soda in sufficient proportion to neutralise the alkali, and then placing the resulting liquid on a dialyser. The addition of hydrochloric acid must be repeated three or four times, and the dialysis continued for several days in order to remove the whole alkali. It is remarkable that the *purified* acid is not peptised by acids, salts, or alcohol at the ordinary temperature. Evaporated to dryness, it forms vitreous scales, like gum or gelatine, which sometimes adhere so strongly to the surface of the evaporating dish as to detach portions of it. It may be heated to 200° C. without losing its solubility or passing into the pectous state, but at a temperature near redness it undergoes a molecular change, losing at the same time 2.42 per cent. of water. When water is added to unchanged tungstic acid it becomes pasty and adhesive like gum, and it forms a liquid with about one-fourth its weight of water, which is so dense as to float glass. The solution effervesces with carbonate of soda. The taste of tungstic acid dissolved in water is not metallic or acid, but rather bitter and astringent. Solutions of tungstic acid containing 5, 20, 50, 66.5, and 79.8 per cent. of dry acid, possess the following densities at 19° C, 1.0475, 1.2168, 1.8001, 2.396, and 3.243. Evaporated *in vacuo* liquid tungstic acid is colourless, but becomes green in air and light, apparently from the deoxidating action of organic matter. Liquid silicic acid is protected from peptising when mixed with tungstic acid—a circumstance probably connected with the formation of the double compounds of these acids, which M. Marignac has lately indicated.

Molybdic Acid has hitherto been known (like tung-

* Abstracted from the *Proceedings* of the Royal Society, with additions by the author.

stic acid) only in the insoluble form. Crystallised molybdate of soda dissolved in water is decomposed by the addition of hydrochloric acid in excess without any immediate precipitation. The acid liquid thrown upon a dialyser may gelatinise after a few hours, but again liquifies spontaneously, when the salts diffuse away. After repeated additions of hydrochloric acid and a diffusion of three days, about 60 per cent. of liquid molybdic acid remains behind in a pure condition. The solution is yellow; astringent to the taste, acid to test-paper, and possesses much stability. The acid may be dried at 100° , and then heated to 200° without losing its solubility. Dry molybdic acid has the same gummy aspect as tungstic acid, and deliquesces slightly when exposed to damp air. Both acids lose their colloidal character when combined with soda, and give a variety of crystallised salts. The pure liquid acids also become insoluble when heated for some time with hydrochloric and other strong acids.

On the Determination of Water in Organic Substances,
by M. CL. WINCKLER.

THIS determination is founded on the change of colour which anhydrous chloride of cobalt undergoes in absorbing water. Dry chloride of cobalt dissolves in alcohol of a density of 0.792, preserving a beautiful blue colour. Hydrated bodies in presence of this solution abandon their water, and the colour turns to red. The operation is begun by titrating the solution of cobalt, to ascertain the quantity of it which must be added to a certain amount of water to produce a fixed colour. In this way the author has determined the alcoholic strength of mixtures of alcohol and water.—*Bulletin de la Société Chimique*, vi., 460, 64.

A New Method of Estimating Sulphuric Ether,
by MM. REGNAULD and ADRIAN.

THE purity of ether is commercially estimated by its density, but this is not a rigorous mode of determination, since it is disputed what instrument is to be used. There is also the incorrectness in the graduation of commercial instruments, and, moreover, the temperature is not taken into account.

Some degree of regularity is attained by using a gravimeter, but by itself this determination is insufficient, since the ether is mixed at the same time with water and alcohol in variable proportions.

The first step towards obtaining a correct estimate is to simplify the nature of this complex product.

Having ascertained that carbonate of potash completely dehydrated ether, the authors found that the same salt brought alcohol mixed with ether to 98° centesimal without going beyond.

These points established, they base their process on the estimation of the degree of purity of ether by determining its density before and after the action of dry carbonate of potash. They have arranged a table so as to dispense with calculation. The proportions of pure ether, alcohol, and water contained in any ether can be determined by two gravimetric experiments.

Note.—The temperature for the two experiments should be kept rigorously at $+15$, and the shaking of the mixture with the dry carbonate of potash, which is effected in a stopped flask, should last from twenty-five to thirty minutes.—*Bulletin de la Société Chimique*, vi., 461, 64.

Action of Light on Santonine.—Photo-Santonin Acid,
by M. SESTINI.*

SANTONINE, it is well known, is coloured yellow by exposure to solar light, and this takes place in a vacuum as well as in the air. It does not take place, however, when the actinic rays are cut off by means of a solution of nitrate of uranium.

Crystals of santonine reduced to powder and then exposed to light, not only change colour, but evolve a resinous odour, and acquire a very bitter taste. Water added to this changed santonine acquires a yellow colour, presents an acid reaction, and has a bitter taste. On distillation the same water yields an acid liquid which reduces nitrate of silver and bichloride of mercury, and precipitates acetate of lead white. The author concluded that the volatile matter formed during the colouration of santonine by light was formic acid. On evaporation to dryness the distillate gives a deep red-coloured resinous residue.

By treatment with water the coloured santonine almost entirely lost its odour. On treatment with alcohol it now in great part dissolved, giving a yellowish solution, which, on evaporation, left a reddish-yellow residue, the greater part of which was soluble in ether. The etherial solution left an uncrystallisable residue of an amber colour, and with a very bitter taste.

In subsequent experiments made by exposing santonine to light under water from which all air had been carefully expelled, the author obtained exactly the same results, and hence concluded that by exposure to solar light santonine is changed into formic acid, and an uncrystallisable substance much more soluble in alcohol and ether than santonine itself, and also a red resinous substance. To the yellow uncrystallisable substance he has given provisionally the name *photo-santonin acid*.

The acid, on analysis, gave results which agree very nearly with the formula $C_{11}H_{14}O_3$. Its chemical properties will be described in a future memoir.

On the Estimation of Nitric Acid in Waters,
by M. C. WELTZIEN.†

FINDING that determinations made by the usual methods did not give concordant results, the author adopted the following process. After concentrating the water, the lime and magnesia were precipitated by means of carbonate of soda, and thus nitrate of soda was obtained. The solution of this was evaporated to dryness, the dried residue mixed with finely divided copper, obtained by reducing the oxide by means of hydrogen. The mixture was then placed in a combustion tube, with the precautions necessary in estimating nitrogen by volume.

In such an analysis the author mentions that nitrogen existing in nitrate of ammonia or in organic matter and also in nitrites will be overlooked.

Use of Silica in Organic Analysis, by M. SCHALLER.‡

SOME months ago M. Schaller gave a process for preparing what he supposed to be ferricyanide of ammonium, which is used in making aniline black. His process consisted in substituting ammonium for potassium by double decomposition, but he has since discovered that the whole of the potassium is not exchanged, and that the salt formed is really a double ferricyanide of ammonium and potassium.

* *Bulletin de la Société Chimique de Paris*, July, 1864, p. 21.

† *Ibid.*, August, 1864, p. 87.

‡ *Ibid.*, August, 1864, p. 93.

In the course of his experiments he found a difficulty in estimating the carbon in the presence of the potassium in the compound; and it occurred to him to make a combustion with pure calcined silica in place of oxide of copper. The process succeeded perfectly.

The analysis of bitartrate of potash may be made in the same way, and the carbon and hydrogen estimated at the same time.

The combustion tube is charged in the usual way for estimating carbon and hydrogen, but in place of oxide of copper the substance to be analysed is mixed with about its own weight of silica. The mortar is then rinsed with oxide of copper, which is placed in the tube and shaken with the previous mixture.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, June 3, 1864.

"On Recent Chemical Researches in the Royal Institution,"
by EDWARD FRANKLAND, Esq., F.R.S., Professor of
Chemistry, Royal Institution.

AMONGST the branches of inquiry that have engaged the attention of chemists during the past fifteen years, there can scarcely be two opinions as to the paramount importance of those investigations which have had for their object the discovery of the internal structure of chemical compounds, and especially of organic compounds; for it is by thus studying the architecture of these bodies that we become acquainted with the plans according to which Nature herself constructs them under the influence of what we term vitality, and that we are enabled to imitate her operations. The vast number of organic compounds that can now be produced, without the aid of life in any form, some of them even constituting a part of the food of man, affords ample testimony to the importance of this field and the success with which it has been cultivated.

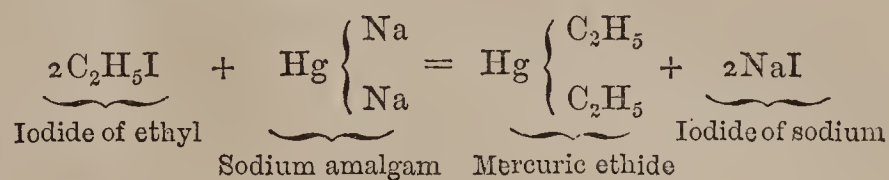
The ultimate analytical composition of a chemical compound affords us little or no information available for the production of that compound artificially; but the moment the internal arrangement of the atoms becomes known the constructive process at once suggests itself. Such a problem may be attacked in two distinct ways, either by taking the compound to pieces, or by building it up from its proximate constituents. More than twelve years ago the speaker had applied the latter or synthetical process to the investigation of organic compounds containing metals, some of the results of which he had communicated to the members on a previous occasion. A like scrutiny must be applied to other families of organic substances if we are to become equally acquainted with their molecular construction. It was the application of the synthetical process to an important family of organic substances that had formed the basis of the investigations recently carried on in the chemical laboratory of the Institution. In the execution of this work the speaker had been enthusiastically joined by his friend, Mr. Duppa, who had in an eminent degree contributed to whatever success had attended their labours.

The family of organic acids thus attacked, and which is represented by lactic acid, had for some years past excited the interest and attention of chemists, but although much laborious investigation had been expended upon it, especially by Kolbe and Wurtz, yet the constitution of these acids was still far from being established. Like any effort to overcome a difficulty, such an investigation required the selection of a plan of attack, and the preparations of the agents, or weapons, by which the assault was to be made. The speaker had already proved in a paper communicated to the Royal Society, that oxalic acid was

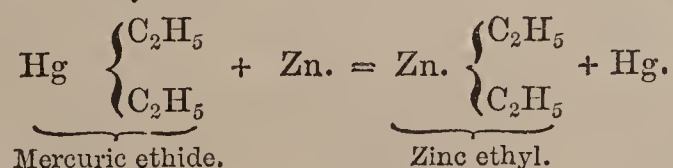
the basis or model of the family of acids to be investigated. This fact showed the path by which the subject was to be approached, and he then went on to describe the principles according to which the weapons were constructed.

In Mechanics the engineer proportions the force which he employs to the effect required to be produced, and it was considered one of the greatest achievements in such control of mechanical force when Mr. Nasmyth's steam-hammer could be made, at one moment to deliver a blow gentle enough to break the shell of a nut without crushing the kernel, and at the next to descend with a force sufficient to smash a block of granite and shake the ground beneath it. As in mechanics, where we deal with masses, so in chemistry, where we have to do with atoms, it is also necessary to apply a properly graduated amount of force, and to apply it in the right direction. Chemistry was yet far behind mechanics in this faculty of graduating force, but by availing ourselves of certain chemical reactions, we had the power, as it were, of gradually storing up force in the atoms of bodies, and of delivering the blow when the force had become strong enough to effect the change required. In this way the comparatively inert radicles or molecules, methyl, ethyl, amyl, &c., could be invested with chemical energy sufficient to force their entrance into oxalic acid. The process of thus endowing these radicles with force was likened to the gradual winding up of a weight to the height necessary for the production of a given effect by its subsequent fall. For this purpose a force external to the atoms to be elevated was obviously required. The first supply of this force was taken from sodium; but sodium, although competent to raise the molecules of ethyl or methyl to a great elevation, was yet too rough in the use of its power, for if we attempted by its sole agency to elevate these molecules, they were actually torn to pieces by the violence of the effort. The action of the sodium must, therefore, be moderated by combining it with mercury; much of its power was thus lost, but sufficient still remained for the purpose, if rightly employed.

This sodium amalgam on being brought into contact with the iodides of methyl, ethyl, or amyl, refused to exert any action, but on the addition of a few drops of acetic ether, which acted in this case like a ferment, the sodium separated the iodine from the ethyl, whilst the latter united itself with the mercury.



By this association with mercury the energy of the ethyl was greatly increased, but it still lacked sufficient power for its attack upon oxalic acid. Having once commenced its ascent, however, the further elevation of the ethyl became comparatively easy. It was only necessary to digest the mercuric ethide, procured as above described, with metallic zinc at a temperature of 100° C. for several hours, in order to replace the mercury with zinc, by which means zinc ethyl was obtained.



The zinc ethyl thus obtained possessed far greater energy than the mercuric ethide from which it was derived,* and, in fact, in this compound the ethyl became fully armed for the contemplated expedition. The speaker, however, showed that its power could be still further increased by the addition of the metal lithium. By these processes the

* The intense chemical energy of zinc ethyl was shown experimentally by a fountain of the liquid, which played perpendicularly to the height of six or eight feet, forming a fiery jet of blue and white flame.

following chemical compounds and weapons of attack had been manufactured :—

Name.	Formula.
Mercuric Methide Hg	$\left\{ \begin{array}{l} \text{CH}_3 \\ \text{CH}_3 \end{array} \right.$
Mercuric Iodo-methide Hg	$\left\{ \begin{array}{l} \text{CH}_3 \\ \text{I} \end{array} \right.$
Mercuric Ethide Hg	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{C}_2\text{H}_5 \end{array} \right.$
Mercuric Iodo-ethide Hg	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{I} \end{array} \right.$
Mercuric Chlor-ethide Hg	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{Cl} \end{array} \right.$
Mercuric Amylide Hg	$\left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{C}_5\text{H}_{11} \end{array} \right.$
Mercuric Iod-amylide Hg	$\left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{I} \end{array} \right.$
Mercuric Chlor-amylide Hg	$\left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{Cl} \end{array} \right.$
Zincmethide Zn	$\left\{ \begin{array}{l} \text{CH}_3 \\ \text{CH}_3 \end{array} \right.$
Zincethide Zn	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5 \\ \text{C}_2\text{H}_5 \end{array} \right.$
Zincamylide Zn	$\left\{ \begin{array}{l} \text{C}_5\text{H}_{11} \\ \text{C}_5\text{H}_{11} \end{array} \right.$
Lithio-mercuric Methide Hg'' Li'	$\left\{ \begin{array}{l} \text{CH}_3' \\ \text{CH}_3' \end{array} \right. ?$
Lithio-mercuric Ethide Hg'' Li'	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5' \\ \text{C}_2\text{H}_5' \end{array} \right. ?$
Lithio-zinc Methide Zn'' Li'	$\left\{ \begin{array}{l} \text{CH}_3' \\ \text{CH}_3' \end{array} \right. ?$
Lithio-zinc Ethide Zn'' Li'	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5' \\ \text{C}_2\text{H}_5' \end{array} \right. ?$

The speaker then described the action of several of these bodies upon oxalic acid, or rather oxalic ether. This action consisted in the removal of one atom of oxygen from oxalic acid, and its substitution by two atoms of ethyl, methyl, &c. Thus, by the action of zinc ethyl, oxalic acid was transformed into leucic acid—a body that had previously been obtained from animal tissues, especially from the spleen and lungs. By acting upon oxalic ether with the zinc compounds of other organic radicles, a large number of acids belonging to the lactic series, and hitherto unknown, could be produced. Many of these acids were isomeric with each other, that is, possessed the same percentage composition, but differed in their interior architecture. Thus leucic acid was susceptible of no less than nine isomeric modifications, three of which had already been obtained by the method now described. The following table shows the internal structure of these isomeric leucic acids :—

$\text{C}_2''' \left\{ \begin{array}{l} \text{C}_2\text{H}_5' \\ \text{C}_2\text{H}_5' \\ \text{O}'' \\ \text{OH}' \\ \text{OH}' \end{array} \right.$	$\text{C}_2''' \left\{ \begin{array}{l} \text{C}_2\text{H}_5' \\ \text{H}' \\ \text{O}'' \\ \text{OC}_2\text{H}_5' \\ \text{OH}' \end{array} \right.$	$\text{C}_2''' \left\{ \begin{array}{l} \text{C}_2\text{H}_5' \\ \text{CH}_3' \\ \text{O}'' \\ \text{OCH}_3' \\ \text{OH}' \end{array} \right.$
$\text{C}_2''' \left\{ \begin{array}{l} \text{CH}_3' \\ \text{CH}_3' \\ \text{O}'' \\ \text{OC}_2\text{H}_5' \\ \text{OH}' \end{array} \right.$	$\text{C}_2''' \left\{ \begin{array}{l} \text{C}_3\text{H}_7' \\ \text{C}_3\text{H}_7' \\ \text{O}'' \\ \text{OH}' \\ \text{OH}' \end{array} \right.$	$\text{C}_2''' \left\{ \begin{array}{l} \text{C}_3\text{H}_7' \\ \text{H}' \\ \text{O}'' \\ \text{OCH}_3' \\ \text{OH}' \end{array} \right.$
$\text{C}_2''' \left\{ \begin{array}{l} \text{CH}_3' \\ \text{H}' \\ \text{O}'' \\ \text{OC}_3\text{H}_7' \\ \text{OH}' \end{array} \right.$	$\text{C}_2''' \left\{ \begin{array}{l} \text{C}_4\text{H}_9' \\ \text{H}' \\ \text{O}'' \\ \text{OH}' \\ \text{OH}' \end{array} \right.$	$\text{C}_2''' \left\{ \begin{array}{l} \text{H}' \\ \text{H}' \\ \text{O}'' \\ \text{OC}_4\text{H}_9' \\ \text{OH}' \end{array} \right.$

The following is a list of acids which, with their compounds, have thus been produced and investigated during the past year in the laboratory of the Institution :—

Name.	Formula.
Dimethyloxalic acid No. 1 C ₂ '''	$\left\{ \begin{array}{l} \text{CH}_3' \\ \text{CH}_3' \\ \text{O}'' \\ \text{OH}' \\ \text{OH}' \end{array} \right.$
Dimethyloxalic Acid No. 2 C ₂ '''	$\left\{ \begin{array}{l} \text{CH}_3' \\ \text{H}' \\ \text{O}'' \\ \text{OCH}_3' \\ \text{OH}' \end{array} \right.$
Leucic Acid No. 1 C ₂ '''	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5' \\ \text{C}_2\text{H}_5' \\ \text{O}'' \\ \text{OH}' \\ \text{OH}' \end{array} \right.$
Leucic Acid No. 2 C ₂ '''	$\left\{ \begin{array}{l} \text{C}_2\text{H}_5' \\ \text{CH}_3' \\ \text{O}'' \\ \text{OCH}_2' \\ \text{OH}' \end{array} \right.$
Leucic Acid No. 3 C ₂ '''	$\left\{ \begin{array}{l} \text{CH}_3' \\ \text{CH}_3' \\ \text{O}'' \\ \text{OC}_2\text{H}_5' \\ \text{OH}' \end{array} \right.$
Ethyl-amyl Oxalic Acid C ₂ '''	$\left\{ \begin{array}{l} \text{C}_5\text{H}_{11}' \\ \text{C}_2\text{H}_5' \\ \text{O}'' \\ \text{OH}' \\ \text{OH}' \end{array} \right.$
Diamyl-oxalic Amyl-ether C ₂ '''	$\left\{ \begin{array}{l} \text{C}_5\text{H}_{11}' \\ \text{C}_5\text{H}_{11}' \\ \text{O}'' \\ \text{OH}' \\ \text{OC}_5\text{H}_{11}' \end{array} \right.$

These reactions proved that lactic acid, the representative of this family of acids, was also cast in the mould of oxalic acid. Thus, the latter deadly organic body was converted by the removal of one atom of oxygen and its substitution by one of hydrogen and one of methyl into the harmless acid of sour milk, a constituent of the juices of the human body, and an agent, no doubt, of importance in the transformations attending animal life. A similar marvellous transmutation of character is met with in the highly poisonous arsenic acid, which, by the exchange of one atom of oxygen for two of methyl, is converted into the innocuous, though perfectly soluble, cacodylic acid.

The speaker concluded as follows :—Here, then, we have a most prolific reaction, capable of furnishing an immense number of new organic bodies, and at the same time indicating to us the very simple manner in which nature evolves some of her, apparently, most complex results. By a species of progressive development, this simply organised oxalic acid becomes gradually elevated, cultivated, and transformed into bodies, which, when viewed by one ignorant of their true origin, appear to possess a hopeless complexity. Not only do we now gain a clear insight into the architecture of these acids, but we can take the very elements of which they are composed, and build them up unaided by any vital processes. We need not even go for oxalic acid, our very type or model, either to the wood-sorrel, or the lichen, which, by means of this acid, corrodes the rock upon which it grows ; for we have the power both to lay the foundation and to build the superstructure of these organic bodies, without the least assistance from either animal or vegetable life. And is it too much to hope that, by analogous inductive scrutiny, even the most obscure and complex physiological phenomena of life itself will one day yield to scientific research, and become to us as clear and simple as they are now dark

and unintelligible? But to accomplish this, the human intellect must prepare itself for efforts far more difficult than any it has yet made. Hitherto, the more palpable and simple phenomena of nature have been the first to attract the attention of philosophers, whilst the more recondite and hidden, constituting increasingly difficult subjects of research, have been left for future explorers. Thus, although we are still scarcely advanced beyond the condition of children gathering pebbles on the shore of the boundless ocean of knowledge, yet those pebbles, never easy to find, are now no longer left dry on the beach. They must be dragged from the grip of the waves by patient and cunning toil. Difficulties innumerable and appalling confront us, but let the human intellect be only left free and untrammelled, and it will surely accomplish the task set before it.

CANTOR LECTURES.

“On Chemistry Applied to the Arts.” By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE V.

DELIVERED ON THURSDAY EVENING, MAY 5, 1864.

(Continued from page 102.)

MILK, its composition, properties, falsification, and preservation. Urine, its uses. A few words on putrefaction.

Milk.—The composition of this important fluid varies not only in different classes of animals, but also in different individuals of the same class. Further, the composition of milk is modified by the influence of food, climate, degree of activity, and health. Notwithstanding these variations, an average can be arrived at by numerous analyses, and the following table will give a general idea of milk:—

	Woman's.	Cows'.	Asses'.	Goats'.	Ewes'.
Dried Caseine ..	15.2	44.8	18.2	40.2	45.8
Butter ..	33.5	31.3	1.1	33.2	12.0
Sugar of milk ..	65.0	47.7	60.8	52.8	50.0
Salts ..	4.5	6.0	3.4	5.8	6.8
Water ..	881.8	870.2	916.5	868.0	885.4
	1000.0	1000.0	1000.0	1000.0	1000.0

The various substances comprised in milk may be classified under three heads—cream, curd or caseine, and whey.

Cream, according to Dr. Voelcker's* analysis, is composed of:—

Water	...	61.67	...	64.80
Butter	...	33.43	...	25.40
Caseine	...	2.62	...	7.61
Sugar of milk	...	1.56	...	...
Mineral matters	...	0.72	...	2.19
		100.00		100.00

And may be considered as consisting of small, round, egg-shaped globules, composed of fatty matters, enclosed in a thin cell of caseine, which, being lighter than the fluid containing them, rise to the surface and constitute cream, and in proportion to the quantity of this removed from the milk, the latter becomes less opaque, and assumes a blue tinge. When exposed to the air for a short time in a dry place it loses water, becomes more compact, and constitutes what is called cream cheese. When churned, cream undergoes a complete change; the caseine cells are broken, and the fatty globules gradually adhere one to the other and form a solid fatty mass, called butter, and it is found,

on an average, that 28 lbs. of milk will yield 1 lb. of butter. Fresh butter is composed of:—

Fatty matters	{ Margarine Oleine Caproine Caprine Butyrene Caproleine }	...	...	77.5
Caseine	...	...	...	1.6
Whey ...	...	...	...	20.9
				100.00

But as butter rapidly becomes rancid, it is necessary to adopt means to prevent this as much as possible, and the following are the usual methods—viz., working the butter well with water, and then adding 3 or 4 per cent. of common salt, or melting the butter at a temperature below 212°; but the following method, employed by M. Bréon, appears to give general satisfaction—It consists in adding to the butter, water containing 0.003 of acetic or tartaric acid, and carefully closing the vessels containing it. The rancidity of butter is due to a fermentation generated by the caseine existing in it, which unfolds the fatty matters into their respective acids and glycerine, and as the volatile acids, butyric, caproic, &c., have a most disagreeable taste and odour, it is these which impart to butter the rank taste. Allow me to add, *en passant*, that whilst butyric acid possesses a repulsive smell, its ether has a most fragrant odour—viz., that of pineapple, for which it is sold in commerce.

Curd of Milk or Caseine has, according to Dr. Voelcker, the following composition:—

Carbon	...	...	...	53.57
Hydrogen	...	...	...	7.14
Nitrogen	...	...	...	15.41
Oxygen	...	...	...	22.03
Sulphur	...	...	...	1.11
Phosphorus	...	...	...	0.74
				100.00

And is easily recognisable by its white flocculent appearance. It is insipid and inodorous, like albumen, from which it differs in its insolubility in water, though it is dissolved by a weak solution of alkali or acid. But what chiefly distinguishes caseine is that it is not coagulated on boiling, and that rennet precipitates it from its solutions. Dr. Voelcker has proved, however, in his researches on cheese, that the commonly-received opinion that rennet coagulates milk by decomposing the lactine into lactic acid is incorrect, for he has coagulated milk while in an alkaline condition, and it is owing to the difference in the action of rennet on albumen and caseine that chemists have been able to detect the presence of $\frac{1}{2}$ to $\frac{3}{4}$ per cent. of albumen in milk. This important organic substance not only exists in milk, but is also found in small quantities in the blood of some animals, such as the ox, and in a large class of plants, but more especially in the leguminous tribe, such as peas, beans, &c. Caseine is the basis of all cheeses, and when these are made with milk from which the cream has been previously taken the cheese is dry, but when part of the cream has been left the cheese is rich in fatty matters as well as in caseine; and I may add that the peculiar flavours characterising different cheeses are caused by modifying the conditions of the fermentations which the organic matters undergo. The following researches made by M. Blondeau illustrate this point, as well as the modifications which cryptogamic life under peculiar circumstances may effect in the composition of organic substances, and his interesting results were obtained in studying the conversion of curd into the well-known cheese of Roquefort. He placed in a cellar some curd of the following composition:—

* For further particulars on this subject, the reader is referred to Dr. Voelcker's paper, published in the *Journal of the Royal Agricultural Society of England*, volume xxiv.

Caseine ...	...	...	...	85.43
Fatty matters ...	...	...	...	1.85
Lactic acid ...	...	...	...	0.88
Water ...	...	...	...	11.84
<hr/>				
100.00				

To which he added a small quantity of salt. After a month, and again after two months, he analysed portions of the same, with the following results:—

	After one month.	After two months.
Caseine ...	61.33	43.28
Fatty matters ...	16.12	32.31
Chloride of sodium ...	4.40	4.45
Water ...	18.15	19.16
Butyric acid ...	—	0.67
<hr/>		<hr/>
100.00		99.87

The above figures show a most extraordinary change in the caseine or curd, for we observe that the proportion of caseine gradually decreases, and is replaced by fatty matters. Considering the circumstances under which this phenomenon has occurred, there can be doubt that this curious conversion of an animal matter into a fatty one is due to a cryptogamic vegetation or ferment; and if the Roquefort cheese be exposed to the air under a bell jar for twelve months, the decomposition becomes still more complete; for it is no longer the caseine which undergoes a transformation, but the oleine of the fatty matters. The following analyses clearly illustrate this curious action. Composition of the cheese after two and twelve months:—

	After 2 months.	After 12 months.
Caseine ...	43.28	40.23
Margarine ...	18.30	16.85
Oleine ...	14.00	1.48
Butyric acid ...	0.67	—
Common salt ...	4.45	4.45
Water ...	19.30	15.16
Butyrate of ammonia...	—	5.62
Caproate of ammonia ...	—	7.31
Caprylate of ammonia...	—	4.18
Caprate of ammonia ...	—	4.21
<hr/>		<hr/>
100.00		99.49

The substances to which cheeses owe their peculiar flavour are ammoniacal salts, chiefly composed of various organic acids, such as acetic, butyric, capric, caproic, and caproic. I cannot better conclude my remarks on cheese than by extracting from Dr. Voelcker's interesting papers a few of his numerous analyses of different kinds of cheese:—

	Cheshire.	Stilton.	Old Cheddar.	Double Glo'ster.	Single Glo'ster.	American.
Water	32.59	20.27	30.32	32.44	28.10	27.29
Butter	32.51	43.98	35.53	30.17	33.68	35.41
†Caseine	26.06	33.55	28.18	31.75	30.31	25.87
Sugar of milk	4.53		1.66	1.22	3.72	6.21
Lactic acid	4.31		4.31	4.42	4.19	5.22
†Mineral matter	—	2.20	—	—	—	—
<hr/>						
100.00						
<hr/>						
†Nitrogen	4.17	3.89	4.51	5.12	4.85	4.14
†Common salt	1.59	0.29	1.55	1.41	1.12	1.97

The principal application of caseine in arts and manufactures is that first introduced by Mr. R. T. Pattison, who used it under the name of lactarine for fixing pigments in calico printing. His process consists in drying the washed curds of milk, which he sells to the calico printer, who mixes it with a solution of ammonia or weak alkali, which swells it out and renders it soluble in water. To a solution of this substance, of proper consistency, he adds one of the tar colours, prints it, submits the goods to the

action of steam, which drives off the ammonia, leaving fixed on the fabric the caseine and colour. In consequence of the insoluble compound which caseine forms with lime it has often been used as a substitute for glue or linseed oil in house painting, and it may be useful to some of my audience to know that when caseine is dissolved in a concentrated solution of borax, an adhesive fluid is formed, which is capable in many cases of serving the purposes of glue or starch. Mr. Wagner has made another useful application of caseine, mixing it with six parts of calcined magnesia and one part of oxide of zinc, and a sufficient quantity of water to make a pasty mass, which he leaves to solidify, and when dry it is extremely hard, susceptible of receiving a high polish, and is sold as a substitute for meerschaum.

Whey.—According to Dr. Voelcker, the composition of whey is as follows:—

Water ...	...	...	...	89.65
Butter ...	...	...	...	0.79
Caseine ...	...	...	...	3.01
Sugar of milk ...	...	...	...	5.72
Mineral matters ...	...	...	...	0.83
<hr/>				
100.00				

When whey is concentrated to the state of syrup and kept in a cold place, it gradually deposits fine, well-defined crystals, which, on further purification and re-crystallisation, yield white quadrangular prisms of a substance called lactine, or sugar of milk, which is highly interesting. It is remarkable that while sugar of milk has only been known in Europe for a comparatively short period, where homœopathists are its principal employers, in India lactine has been known for a great number of years. Let us now study some of the chemical facts connected with sugar of milk. Thus cane sugar, when acted upon by nitric acid, gives oxalic acid, whilst lactine gives mucic acid; cane sugar, when unfolded under the influence of a ferment, gives alcohol and carbonic acid; lactine yields lactic acid. As the latter transformation is most important, in a physiological and chemical point of view, allow me to dwell upon it for a few minutes. The substance which possesses the property of most readily converting lactine into lactic acid is caseine after it has undergone some peculiar modification, which renders it a ferment. Thus when milk leaves the cow it is alkaline, but when exposed to the air it rapidly becomes acid, and this is due to the conversion of lactine into lactic acid, a change most interesting as a chemical fact, since both lactine and lactic acid have the same composition, the only difference being that two equivalents of oxygen and two of hydrogen cease to exist as such in the acid, but may be considered as combined in the form of water with the remaining elements—



M. Pasteur has shown that this lactic fermentation is not merely confined to milk, but that it is a peculiar fermentation, differing from the previous one, which frequently occurs during the decomposition of organic matters, and is due to a distinct ferment of its own; and his researches on lactic fermentation have explained the fact, observed by M. Pelouze, some years since, that when a vegetable substance, such as sugar or starch, was put in contact with chalk or other alkali and an animal substance, lactic fermentation ensued, but until the researches of M. Pasteur, we did not know why sugar and starch in these circumstances should give lactic acid instead of alcohol and carbonic acid, which would be the result of a fermentation produced by yeast. Lactic acid is a most interesting substance to the physiologist, for it is found in large quantities, free or combined with lime, in gastric juice, in the muscular part of animals, or with soda, in blood, and its production is easily accounted for when we remember that it can be produced from the starch and sugar existing in our food. When lactic acid is purified by various

chemical means and separated from the fluid in which it is combined, it presents itself as a syrupy fluid, of an intensely acid reaction, which, when submitted to the action of heat, first loses its one equivalent of water, and becomes anhydrous lactic acid, and on a further application of heat loses still one equivalent of water, and is transformed into a neutral substance called lactide. This acid, in a free state, has not yet received any important application in art and manufactures, but I have little doubt that it will some day be largely employed, for we have noticed in a former lecture its advantageous use when produced from rye and other amylaceous substances in removing the lime from various skins intended to be tanned or prepared as there described, and Mr. E. Hunt has used it in the form of sour milk for the conversion of starch into dextrine (see *Journal of the Society of Arts*, December 23, 1859). I wish now to say a few words on the mineral substances existing in whey, and which play a most important part in milk as a nutritious substance. We are all of us too apt to overlook the importance of the mineral elements in food, and to consider as essential the organic matters only. In milk, however, its alkaline salts, and especially the phosphate of lime, are as essential (as food) as caseine or fatty matters, for if an infant requires the lactine to maintain respiration and the heat of the body, the caseine to contribute to the formation of blood, the phosphate of lime is equally essential to the production of bone; permit me here to state that the practice adopted by some mothers of feeding infants upon amylaceous substances, such as arrowroot, sago, tapioca, &c., in place of milk, is most pernicious, for these contain neither flesh nor bone forming element, and milk is the only proper food for infants.

Having now examined the general properties of some of the most important constituents of milk, let us say a few words on that fluid in its integrity. We all know how rapidly milk becomes sour, especially at a temperature of 70° to 90°, and as this is owing, as already explained, to the formation of lactic acid, the best way to preserve milk sweet for domestic purposes is to add to it every day a few grains of carbonate of soda per pint, to keep the milk alkaline. The possibility of preserving milk for a lengthened period has repeatedly occupied the attention of scientific men, as a most important problem to solve for the benefit of persons undergoing long sea-voyages, but up to a recent date with very imperfect success. One of the best plans proposed is to add to milk 7 or 8 per cent. of sugar, and evaporate the whole, agitating all the time to prevent the formation of the skin, and when reduced to one-fifth of its bulk to introduce it into tin cans, which, after being subjected for half an hour to a temperature of 220°, are hermetically sealed. In 1855, l'Abbé Moigno drew the attention of the members of the British Association at Glasgow to milk which he stated contained nothing injurious, and which would keep for a long period. This statement has proved correct, for I have here some milk which has been in the hands of the secretary of this Society since that period, and which, on being opened to day, was found perfectly sweet. But if l'Abbé Moigno's process has remained a secret, M. Pasteur has succeeded in affecting the same end, and probably by the same method. Thus he has found that if milk be heated to 212° it will only remain sweet for a few days, if heated to 220° it will remain sweet for several weeks, but if to 250° (under pressure, of course) the milk will keep for any length of time. This, according to M. Pasteur, is owing to the spores or eggs which generate lactic fermentation being destroyed by the high temperature, and thus the possibility of fermentation is put an end to. The adulteration of milk by various substances stated to have been discovered therein, has, I think, been greatly over-estimated, as I have never found any of them in the samples of milk which I have analysed; in fact, the most

easy and cheapest of all is the addition of water. It is comparatively easy to ascertain if milk has been tampered with; but, without entering into details of the methods necessary to estimate the exact extent of adulteration, I may mention the following plan:—If a glass tube, divided into 100 equal parts, is filled with milk and left standing for twenty-four hours, the cream will rise to the upper part of the tube, and, if the milk is genuine, will occupy from 11 to 13 divisions. Another practical method is to add to the milk a little caustic soda, and agitate the whole with a little ether and alcohol, which dissolves the fatty matters; this ethereal solution is removed from the milk and evaporated, when the fatty matters remain, and experience has shown that 1000 parts of good milk will yield 37 parts of fatty matters. Any milk leaving no more than 27 must have been tampered with. Dr. Voelcker suggests the employment of a hydrometer as a means of ascertaining the quality of milk, as the specific gravity of that fluid is an excellent test. From a great number of experiments he has ascertained that good new milk has a specific gravity of 1.030, whilst if good milk is adulterated with 20 per cent. of water its specific gravity will fall to 1.025.

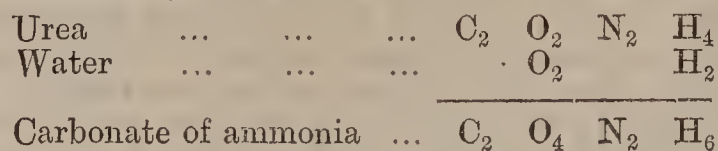
Urine is a fluid secreted by the kidneys, which organs separate from the blood as it circulates through them any excess of water it may contain, as well as many organic substances which have fulfilled their vital function in the animal economy, and which require to be removed from the system. The composition of urine varies greatly in different individuals, and in the same individual at different times, and is influenced by diet, exercise, state of health, &c., as shown by Dr. Bence Jones and Dr. Edward Smith, but without detailing these variations, which would occupy far more time than the limits of a lecture would permit, allow me to call your attention to the following table, showing the composition of human and herbivorous animals' urine:—

HUMAN.				
Water ...	...	...	...	933.000
Urea ...	...	...	...	30.100
Lactic acid ...	...	...	...	17.140
Lactate of ammonia ...	...	...	...
Extractive matter ...	...	...	...
Kreatine ...	...	...	...
Kreatinine ...	...	...	...
Hippuric acid ...	...	...	...	1.000
Indican ...	...	...	...
Colloid acid (W. Marcet) ...	...	...	...
Uric acid ...	...	...	...	0.320
Mucus ...	...	...	...	18.440
Mineral salts ...	...	...	...	1000.000
HORSES.				
Water ...	...	...	...	910.76
Urea ...	...	...	...	31.00
Hippurate of potash ...	...	...	...	4.74
Lactate of do. ...	...	...	...	11.28
Do. of soda ...	...	...	...	8.81
Bicarbonate of potash ...	...	...	...	15.50
Carbonate of lime ...	...	...	...	10.82
Carbonate of magnesia ...	...	...	...	4.16
Other salts ...	...	...	...	2.93
				1000.00

The substances in human urine which call for special notice are urea and uric acid; in herbivorous animals, hippuric acid; and in birds, uric acid.

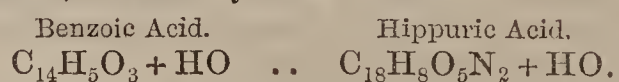
Urea is a substance crystallising in various derivative forms belonging to the prismatic system—it is very soluble in water and alcohol, and gives beautiful and well-defined salts with nitric and oxalic acids. Urea, under the influence of a mucous substance secreted at the same time, and which is easily modified into a ferment, is rapidly converted, by

the fixation of two atoms of water, into carbonate of ammonia, as seen by this formula :—



This will explain the strong ammoniacal odour arising from urine after being kept for a short time; and as it may be most important for medical men to be able to preserve urine in its normal condition for several days, I observed a few years since a most effectual method of preserving it, which is merely the addition of a few drops of carbolic acid immediately after the production of the urine. Urea is peculiarly interesting to chemists, as it was the first organic substance which they succeeded in producing artificially from mineral compounds. This interesting discovery was made by Wöhler in 1820, in acting upon cyanate of silver by hydrochlorate of ammonia. Since then Baron Liebig has devised a more simple process, which consists in decomposing cyanate of potash by sulphate of ammonia, which gives rise to sulphate of potash and cyanate of ammonia or urea. The average quantity of urea rejected daily by an adult man is about an ounce, or $2\frac{1}{2}$ per cent. of the fluid itself. Although human urine does not contain more than 1 per cent. of uric acid, and this generally combined with soda, still I deem it my duty to say a few words respecting it, for it is often the principal source of gravel and calculus, owing to various influences which make the urine strongly acid before its rejection, whereby the soda is neutralised, the uric acid liberated, and this being nearly insoluble, separates, and has a tendency to form gravel or calculus. In fact, the deposit which occurs in this fluid is generally represented by uric acid, phosphate of lime, and magnesia, mucus, and colouring matter. It may be here stated that calculi were formerly held in great estimation, especially those formed in the intestine, and called bezoards, and this was the case in Eastern countries until very recently. Thus it is related that a Shah of Persia sent to Napoleon the First, among other valuable presents, three bezoards, which were considered to be of great antiquity, and capable of curing all diseases. The urine of birds and reptiles being almost entirely composed of urate of lime, explains why their refuse is of such value as a manure, which arises from its transformation into carbonate of ammonia. When large masses of this refuse undergo a slow and gradual decomposition, as in the dry climate of the Pacific Islands, on the coasts of Peru and Chili, it constitutes guano. It may be interesting to know that in 1835, 6, and 7, a most beautiful colour was prepared from the uric acid contained in guano, and used largely by calico printers and silk dyers under the name of Roman purple, or murexide.*

Before leaving the study of this important animal secretion, let me say a few words on the urine of herbivorous animals. It is generally alkaline, and contains, besides an aromatic principle, an acid discovered by Liebig, and called hippuric acid, together with urea and uric acid, also found in human urine. Hippuric acid is easily obtained in the form of well-defined crystals, by rapidly evaporating the fluid containing it. This acid does not exist in the food of the animal; but benzoic acid, or its homologues, are found there, and during the phenomena of digestion the nitrogenated principles produced by the wear and tear of life fix themselves on the benzoic acid, and convert it into hippuric, as seen by this formula :—



A further proof of the correctness of this view is that when hippuric acid is treated with strong acids or alkali, it transforms itself into benzoic acid, which can be easily extracted.

ACADEMY OF SCIENCES.

August 22.

MM. PELOUZE and MAUREY contributed a long memoir "*On Pyroxyline*." It contained an account of the different processes employed by the Austrian Government at Hirtenberg, and the French Government at Bouchet, with the relative values of the two products. The superiority of the Austrian cotton, it is said, is shown by its not being spontaneously inflammable, and by the fact that its explosive force can be easily regulated. The authors of this memoir, with some assistants, have experimented in order to ascertain the value of these assertions. They first describe the processes followed at the two manufactories. At Hirtenberg they use a mixture of one volume of monohydrated nitric acid, and three of sulphuric acid, and immerse the cotton for forty-eight hours. At Bouchet a mixture of one of nitric and two of sulphuric acid is employed, and the cotton is immersed for an hour only. The French never use a soluble silicate.

The next point is the yield of cotton. On this the Austrians are silent, but the authors assert that at Bouchet 100 of cotton give 165.25 of gun-cotton. In the laboratory, operating on small quantities, the authors obtained 178.

With regard to the composition, Pelouze, in 1847, announced the composition of pyroxyline to be—



his most recent experiments lead him to adopt the formula—



a formula which involves the increase of 100 of cotton to 177.78. We see above that the authors obtained 178.

The authors next examine the effect of heat on pyroxyline, a point which we may pass over for the present. They next experimented on the projectile force of the two cottons, and found a slight difference in favour of the French.

In conclusion they tell us that although we have learnt something about the mode of production, composition, and chemical properties of gun-cotton, our knowledge of its use in firearms remains in about the same state as it was left by the French commission in 1846.

A lengthened discussion seems to have followed the reading of the memoir, from which we need only quote one remark of General Morin, who said that the Austrians had never communicated their secrets to other Governments, until they had discovered by costly experiments that they were not of the smallest value.

M. Margueritte presented "*A third note on the Theory of Steelification*"—if we may be allowed the word. We need only quote the last paragraph. The truth is, he states, that nobody yet can prove whether steel is a nitro-carbide, a phospho-carbide, a silico-carbide, a manganocarbide, a chromo-carbide, a titano-carbide, or a tungstocarbide, &c., &c., of iron. But there is a typical steel, a carbide of iron, which becomes modified by the influence of all the other metals and metalloids which may combine with it.

M. Roux contributed a memoir "*On the Saltiness of the Sea*," from which we can learn nothing.

M. Chautard presented a note "*On the Phenomena observed in Spectra produced by the Spark of an Induction Current in Rarefied Gases*." The author's experiments were undertaken to ascertain the effect of gradually diminishing the intensity of the current.

M. Schlösing gives yet another process for the determination of phosphoric acid in earthy phosphates. This author reduces the acid and volatilises the phosphorus, passing the vapour into a solution of nitrate of silver, and weighing the last, subsequently converting the phosphide into phosphate of silver. He mixes the phosphate with silica, places the mixture in a carbon boat, puts that in a porcelain tube, heats it to a white heat, and passes car-

* See, for further details, my lecture at this Society, February 5, 1862.

bonic oxide. The phosphorus can be estimated by difference, but the author prefers to pass the gases through nitrate of silver, and converting, as we have said, the phosphide into phosphate. We shall give the process at length shortly, and need now only mention further that some red phosphorus condenses in the porcelain tube, and requires to be rinsed out.

M. Michaelson contributed a note "*On Butylic and Propylic Aldehydes.*" Limpricht and Piria have proved that a corresponding aldehyde is formed when formiate of lime is distilled with the lime salt of an acid. The author accordingly tried to obtain butylic aldehyde by distilling a mixture of formiate and butyrate of lime. He did, in fact, obtain it, but found it to be accompanied by propylic aldehyde.

MM. Millon and Commaille presented a note "*On the Analysis of Milk.*" The subject being of much practical interest, and as the paper introduces two new constituents, we shall give it in full. Lactoproteine we noticed in a previous communication of the authors. The odourous principle they separate by means of bisulphide of carbon, which, it seems, does not dissolve the butter, but extracts the perfume of the milk, which is sometimes agreeable and sometimes not, according to the nature of the fodder, the authors say. With regard to colour, they say that the butter of cows' milk is always yellow, but that of goats, sheep, women, and asses is always colourless.

M. Commaille also contributed "*A New Method of Estimating Vegetable Astringent Matters.*" Some vegetable matters decompose iodic acid in the presence of prussic acid, and some do not. Among the former are the astringent matters. Accordingly the author adds to a vegetable decoction, some very weak prussic acid, and a measured quantity of a solution of iodic acid of known strength, and subsequently determines the amount of unchanged iodic acid. One gramme of gallic acid will destroy 2.366 grammes of iodic acid and one gramme of tannin 2.320.

A short note by M. Blondeau "*On the Action of Ammonia on Starch*" makes known the fact that the two placed in contact give rise to a compound which represents an equivalent of each in combination. It is a weak base to which the author has given the name *amidiaque*. Guided by analogy, we suppose we ought to call it *amidia*.

NOTICES OF BOOKS.

Poggendorff's Annalen der Physik und Chemie.
August, 1864.

THIS journal opens with a long and valuable paper "*On the Spectra of the Flames of Various Gases,*" by Dr. Dibbits. It includes observations made on the flame of hydrogen burnt in air, in oxygen, nitrous and nitric oxide, and in chlorine; and also of carbonic oxide and cyanogen burnt in air, oxygen, and nitrous oxide. The flames of ammonia, sulphuretted hydrogen, and of some other gases are also examined under various conditions, the whole forming a most valuable contribution to our knowledge of the subject. A curious fact, discovered by the author, is that a solution of sulphate of quinine does not fluoresce with the light of the flame from hydrogen, hydrocarbons, and ammonia, but does with the flames of carbonic oxide, cyanogen, sulphur, and, indeed, all sulphur compounds. When fluorescence does take place it is always strongest with the flame in oxygen. Another valuable paper is by Landolt, "*On the Influence of the Atomic Constitution of Volatile Compounds of C, H, and O on the Propagation of Light.*" Other papers interesting to chemists are one by Krönig, "*On the Series of Weights most convenient for Laboratory Use, with Hints on Weighing;*" another by Rammelsberg, "*On the Crystalline Form of Bromide of Barium.*" A description of "*A New Saccharimeter,*" by H. Wilde. Dr. Carl Bischof gives "*A Preliminary Notice of a New Earth,*" which he has discovered in a lime mineral. The most distinctive

peculiarities of this earth appear to be that it forms a volatilisable chloride and a hydrated oxide, which is soluble in water; it gives no peculiar blow-pipe reactions, and shows nothing in the spectroscope. We shall hear more of this earth when the author has a larger quantity to experiment with. It is hardly necessary to say that, as usual, Poggendorff contains various papers on Physics of great value to advanced readers.

Annalen der Chemie und Pharmacie. August, 1864.

THE first paper is by Than, "*On the Anomalous Vapour of Sal Ammoniac.*" As it bears on the discussion recently noticed in M. Wurtz's lectures, we shall devote some space to the subject on a future occasion. At present we need only say that the author confirms the views of Wanklyn and Robinson, and disagrees with Deville. Kammerer and Carius have a paper "*On a New Class of Organic Acids,*" the names of which will indicate the nature—Benzo-sulphuric, aceto-sulphuric, and succino-sulphuric acids—the mode of formation, constitution, and some of the salts of these are described. Another paper by Carius is "*On the Isomerism of Aldehyd with the Oxides of Poly-equivalent Alcohol Radicals.*" Kekulé contributes two papers, one "*On the Action of Hydriodic Acid on Iodine Substitution Products,*" and the other "*On the Action of Hydriodic Acid on Polyatomic Acids.*" Dr. Stude gives a further account of "*Everniin,*" a glucogenous substance he obtained from *Evernia Prunastri*, and also of pectin and another new glucogenous substance which appears to be combined with pectin. Three short papers conclude a very interesting number of this journal. The titles of these are—"On the Action of Phenylic Acid and Aniline on Urea," by Baeyer; "*On a Compound of Cyanamid with Aldehyd,*" by C. A. Knap; and "*On the Inversion of the Absorption-bands of the Didymium Spectrum,*" by Bunsen.

Zeitschrift für Chemie und Pharmacie. Heft 16, 1864.

A NOTICE of most of the papers in this number has already appeared in the CHEMICAL NEWS from their original sources; but the first "*On the Action of Sodium Amalgam on Nitrotoluol,*" by Werigo, deserves mention, since the author is anxious to reserve the investigation. By the above action the author has obtained a body which crystallises from hot alcohol in silky needles of a reddish-yellow colour, and which fuse at 100° to a reddish liquid. With bromine they yield a sublimable product. Cymol has been treated in a similar way, but the results are not given. In a paper "*On the Molecular Weight of Subchloride of Mercury,*" Dr. Erlenmeyer confirms the fact mentioned recently by Dr. Odling, that in a state of vapour calomel splits up into Hg and HgCl₂.

NOTICES OF PATENTS.

RELATING TO THE PRODUCTION OF COAL-TAR COLOURS.
(Continued from page 272.)

475. *Improvements in the Treatment of Colouring Matters derived from Tar, for the purpose of making them applicable for Painting.* E. T. HUGHES, Chancery Lane, London. A communication. Dated February 21, 1863.

IN order to prepare cakes of red, blue, violet, and other colours for painting, the inventor combines the well-known pigments derived from coal-tar with soap and alumina, or sulphate of baryta, in a moist state. The proportions may be varied, but the following are said to succeed: 150 parts of white curd soap are dissolved in 1000 parts of hot water, and then mixed with the solution, in alcohol or methylated spirit, of 6 parts of the crystallised or solid coal-tar pigment. To this mixture is then added 250 parts by weight of gelatinous alumina, the whole well stirred, and the product collected on a filter, drained, and afterwards divided into cakes and dried.

If it be required to obtain colours which are soluble in water or oils, the inventor employs the soap alone in combination with a suitable colouring matter, and these may be very considerably modified by admixture; thus, he prepares a fine yellow cake from picric acid, or the picrate of lead, or from the compounds of this substance with earthy bases. This product may then furnish a green colour by admixture with aniline blue, or an orange tint by being combined with one of the red pigments derived from coal-tar. These colours are stated to possess the qualities of brilliancy and permanence, and to be available for many purposes in the arts.

660. *Making Dyes from Aniline and its Analogues.* R. T. MONTEITH, St. Malo, France, and R. MONTEITH, Manchester. A communication. Dated March 11, 1863.

THE inventors procure two distinct shades of brown, both of which are suitable for dyeing, by acting upon magenta or aniline red with a salt of aniline, at a temperature of about 390° Fahr., and in a vessel which may either be open or closed. From one to six hours is an ordinary period for continuing the application of heat, and the brown mass resulting is treated first with boiling water to remove that portion which is soluble, and the remainder is afterwards dissolved in alcohol or methylated spirit to furnish a solution, which is well fitted for dyeing yarns or textile fabrics of a rich brown colour.

717. *Manufacture of Brown Colouring Matters.* G. DE LAIRE, Paris. A communication. Dated March 17, 1863.

THIS invention differs from the foregoing by specifying the employment of *blue* or *violet* dyes (instead of magenta) in conjunction with a salt of aniline—by preference the hydrochlorate—which mixture is heated for the purpose of forming the brown dyes.

700. *Colouring Matters for Dyeing and Printing.* W. BOALER, Manchester. A communication. Dated March 14, 1863. (Not proceeded with.)

THIS claim refers generally to the employment of gases, as generated by the chemical action of acids upon metals, for the purpose of effecting the conversion of aniline or its homologues into useful colouring matters by partial oxidation.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1880. Elizabeth Brimson, Frome, Somersetshire, "Improvements in envelopes or covers for bottles and jars."—Petition recorded July 28, 1864.

1913. Henry Carter, Camberwell New Road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dyeing and printing."—Petition recorded August 1, 1864.

1916. Frederick Daniel Delf, Liverpool, Lancashire, "An improved apparatus for coating fabrics or materials with medical or other compounds, also applicable for ironing purposes."

1920. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of glazes or enamels for pottery ware."—A communication from Dominique Grosjeau, Cosseneu, near La Motte Beuvron, France."—Petitions recorded August 2, 1864.

1963. Niel McHaffie, Broad Street, Glasgow, "Improvements in treating iron plates for shipbuilding, boiler making, and similar uses, and also wrought iron in other forms, to render it capable of resisting oxidation or destruction by sea and other water, and atmospheric and other corroding influences."—Petition recorded August 6, 1864.

1496. Thomas James Hughes, Albany Street, Middlesex, and William Henry Hotten, Hope Street, Hackney,

Middlesex, "An improved composition to be used for coating surfaces, and insulating metal from metal."—Petition recorded June 16, 1864.

1570. Alexander Hett, London, and Frederick William Bassett, Camberwell, Surrey, "Improvements in preserving animal and other substances."—Petition recorded June 23, 1864.

1602. Charles Denis, Arras, France, "Improvements in gas-heating or cooking-stoves."—Petition recorded July 25, 1864.

1937. Bernard O'Connor, Manchester, Lancashire, "An improved method of making non-inflammable plain and twilled dyed cotton fabrics, called jeannetts, beetle-twills, rolled shirtings, fancy and striped and spotted shirtings, and other cotton goods, printed or otherwise, used for lining dresses and making crinolines."

1950. Giacomo Felice Marchisio, Baker Street, Middlesex, "An improved apparatus for generating inflammable air for illuminating and heating purposes, and supplying the same to the burners."—Petitions recorded August 4, 1864.

1962. Charles Bartley, Blackheath, Kent, "Improvements in compositions for preventing the bottoms of iron ships from fouling or corroding."—Petition recorded August 6, 1864.

1988. Henry Armistead, Ovenden, near Halifax, Yorkshire, "Improvements in dyeing and sizing or preparing warps for weaving."

1989. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in gilding glass and vitreous surfaces."—A communication from Edouard Dodé, Paris, France.

1994. Charles Lowe, South Bradford, near Manchester, Lancashire, "Improvements in the manufacture of colouring matters."—Petitions recorded August 10, 1864.

2029. Siegmund Moore, Liverpool Street, London, "Improvements in electro gilding."

2033. Edmund Alfred Pontifex, Shoe Lane, London, "Improvements in treating stick lac when manufacturing shell lac and lac dye."—A communication from Thomas Frederick Henley, Boulevard Malesherbes, Paris, France.—Petitions recorded August 15, 1864.

Notices to Proceed.

964. John Riley, Hapton, near Accrington, Lancashire, "An improved sizing substance."—Petition recorded April 16, 1864.

974. George Davies, Serle Street, Middlesex, "An improved respiratory apparatus."—A communication from Albert Galibert, Paris.—Petition recorded April 18, 1864.

1012. George Davies, Serle Street, Middlesex, "Improvements in inhaling apparatus."—A communication from Emile Siegle, Stuttgart, Wurtemberg.—Petition recorded April 22, 1864.

1060. Richard Archibald Brooman, Fleet Street, London, "Improvements in producing photographic pictures photogenically indelible."—A communication from Charles Raphael Maréchal, junior, and Cyprien Marie Tessié du Motay, Metz, France.—Petition recorded April 27, 1864.

1913. Henry Carter, Camberwell New Road, Surrey, "Improvements in the manufacture of green colouring matters to be used in dyeing and printing."—Petition recorded August 1, 1864.

A Cheap Carpet.—We read in "Cosmos" a letter from M. Duchesne Thoreau relating to a pattern taken from a large *tapis* entirely due to the work of a group of spiders in a state of captivity. He expresses his belief that it is quite possible to produce by the aid of such auxiliaries, and without expense, soft and warm carpets; to arrive at which results it would only be necessary to dispose of a number of working spiders, and over a space proportionate to the magnitude of the work desired.—*Chronicles of Zoology*, "Quarterly Journal of Science."

CORRESPONDENCE.

Continental Science.

PARIS, August 30.

SOME interesting statistics have lately been published touching the sugar manufacture of France. The annual production of sugar from beet-root last year amounted to 190 millions of kilogrammes (about 3,700,000 cwts.), made in 380 different manufactories. The number of beets calculated to produce this quantity is estimated at 2532 millions. According to official figures, Great Britain, with a much smaller population than France, entered for home consumption during the year 1863 no less than 11,000,000 cwt. of the same commodity, from which it follows that the Englishman "with fair round belly" consumes between three and four times as much as the thin Frenchman. What a triumph for Bantingism!

Dr. Wiederhold has lately published a rum test, which any of your readers who are fond of that liquor have an excellent opportunity of trying in London at least. Pour 6 drops of sulphuric acid into 20 drops of the suspected liquor. Effervescence takes place, and the sham spirit loses the characteristic aroma which is retained by the genuine article.

There is a story going about here which I repeat to you as it was told to me, in order that, if not true, it may be contradicted by some of your readers, who are better informed as to dates than myself. It is to the effect that Graham is not the discoverer of dialysis, and is as follows:—On April 1, 1854, M. Dubrunfant (whose writings are familiar to most readers of French scientific literature) took out a patent for certain improvements in sugar refining, in the specification of which he declares, first, that when water and molasses are placed in a vessel separated only by an animal membrane, a weak current is set up between the two liquids; and, secondly, that the water carries with it the salts contained in the molasses that by their presence prevent the sugar from crystallising. Graham's celebrated Bakerian lectures on the Osmotic Force, in which he first explained the dialytic action of membranes, was not delivered until June 15 of the same year. The patent was subsequently rendered useless by the discovery of the method of refining sugar by means of baryta. M. Dubrunfant has, however, lately (June, 1863) patented a refining apparatus on the dialytic principle, in which the septa are made of parchmentised paper. An experimental apparatus has been fitted up at the refinery of Courrieres, near Valenciennes. In this apparatus not only are the salts separated from the sugars by dialysis, but the same means are adopted for separating the nitrate of potash contained in them from the other salts.

A large number of eminent scientific men were made commanders, officers, and chevaliers of the Legion of Honour on the occasion of the Emperor's *fête*. Amongst them figures your colleague, the learned Abbé Moigno, editor of *Les Mondes*, who has received a well-merited chevalier's cross.

The comet discovered some time since has proved more disappointing to the Parisian *cométographes* than that of M. Tempel. Owing to the feebleness of its light and the haste it is making to keep up with the sun, the best telescopes fail in making it out distinctly. It seems too bad, after having been tortured as we have been from the intense heat, that we should not have at least one good comet to comfort us for our sufferings.

M. Gautier-Lacroze, of Clermont-Ferrand, has been investigating the exact composition of the alunite of Mont Dore. It occurs in a vein measuring 100 metres in length by 50 to 60 in width, and is almost as hard as quartz. It is greyish-white, and its fracture is conchoidal. It contains numerous particles of sulphur distributed through its mass, which may be extracted with bisulphide of carbon. From a kilogramme M. Gautier-Lacroze obtained

73½ grammes of pure sulphur. Crystals of iron pyrites are also found in it. Its specific gravity is 2.481, and its chemical composition varies slightly. It generally contains about 5 per cent of potash, 25 per cent. of sulphuric acid, and 23 per cent. of alumina, the rest being water, silica, sulphur, and oxide of iron. Hitherto, all efforts to use the Mont Dore alunite have failed, in consequence of the difficulty of pulverising the material; but M. Gautier-Lacroze finds that by roasting the alunite becomes sufficiently friable to work easily.

M. Anthon, of Prague, has devised a means of obtaining sulphate of soda from salt by mixing equivalent quantities of sulphate of lime (gypsum), chloride of sodium, and calcined magnesia, with six or eight times the weight of the salt of water. Through this mixture is passed a current of carbonic acid, which transforms the calcined magnesia into the carbonate. The carbonate reacts on the sulphate of lime, forming carbonate of lime and sulphate of magnesia, the latter salt and the chloride of sodium being decomposed into sulphate of soda and chloride of magnesium. The carbonate of lime is separated by filtration, and the sulphate of soda crystallises out, leaving the chloride of magnesium in the mother liquor. The chloride of magnesium may be evaporated, calcined, and used over again.

Paris has just followed in the footsteps of London in reducing the price of metropolitan telegrams. You can now send a message to any part of Paris for fifty centimes, and the telegraphic administration guarantee that it shall be delivered within half-an-hour from the time it is dispatched.

An invention for printing by a dry process has just been patented here by M. Lebouger. Between the type and the paper is inserted a sheet of manifold paper prepared with lamp-black and glycerin, by means of which the impression is made. It would be interesting to try if a number of impressions could be got with one pull of the press by the interposition of several pieces of prepared paper, as in the ordinary method of manifold writing.

The opinion entertained by Gerhardt, Berthelot, and others, that cholesterin was an alcohol, has received experimental confirmation in the hands of M. Lindenmeyer, who has succeeded in forming the ether. This chemist has also discovered cholesterin in notable proportions in peas, beans, almonds, and other vegetable substances containing large quantities of albumen.

M. Hahn has been investigating the hydrocarbons left after the solution of cast-iron in acids. He finds them to consist of a mixture of *cenanthylene*, caprylene, cetene, and others of the series C_nH_{2n} . These products, I believe, have already been investigated in England in Dr. Percy's laboratory, but I am not aware that the results have been published.

M. Wiederhold has devised a new method of obtaining a brown dye for wool. Peroxide of manganese in fine powder is mixed with dry nitrate of soda and heated to bright redness in a wood furnace. The brownish product obtained is dissolved in water and forms a green solution containing acid manganate of soda (*chameleon mineral*), which gradually becomes red. When wool is steeped in this red liquor the permanganate of soda becomes decomposed, peroxide of manganese being dissolved in the pores of the fibrous tissue. The colour obtained is stated to stand well against the effects of air and light.

A Suggestion.

To the Editor of the CHEMICAL NEWS.

SIR,—Being an earnest advocate for the new atomic weights, I shall feel obliged if you will allow the following suggestion to be published:—

At the approaching meeting of the British Association, why cannot the whole question of doubling the atomic weights be discussed in the chemical section, the vote of

those present taken, and HO be banished for ever from good society, if, as is most probable, the meeting be in favour of 16 as the atomic weight of oxygen?

I am, &c. F.C.S.

August 25, 1864.

Schwartz's Process for Purifying Sugar.

To the Editor of the CHEMICAL NEWS.

SIR,—I read with much pleasure in your valuable paper (page 92, vol. x.) the specification of a patent for separating sugar from molasses. Permit me to make the following remarks. Many more I could make, but I do not wish to trespass too much on your space.

The use of a mixture of acetic acid, which is decidedly the only fit acid for this purpose, and alcohol is by no means new, for as early as 1849 it was tried for awhile on the large scale in some beetroot sugar works in Belgium; but, as might be expected, it did not answer practically for many reasons, among which stands foremost the inflammability of the alcohol, which, moreover, owing to the high temperature which prevails in the sugar refineries, most rapidly evaporates. The idea of separating by centrifugal machines the masses dissolved in alcohol and acetic acid from the sugar is apparently good; but the patentee does not seem to have provided for the construction of centrifugal machines fit to withstand the action of acetic acid; for, even though sugar be present, that acid will not fail to act upon the brass and iron ordinarily used in the construction of centrifugal machines. Evidently Dr. Schwartz has not much practical knowledge of the sugar manufacture and refining; his idea also of recovering the alcohol by passing the air charged with volatilised spirit through or over water is quite impracticable. In one word, the specification abounds in incongruities, and, moreover, will not, as one should expect at first, deprive raw sugar at once of all the uncrystallisable sugar, only leaving all the crystallisable in the centrifugal machine*—i.e., in the interior revolving cylinder thereof. Instead of lime, as mentioned, baryta might be more profitably used, as is actually done in many beet-root sugar manufactories. The idea of applying strong alcohol (95 per cent. at least) for the refining of sugar is no new one; but its use was only applied on a limited scale, solely to drain the sugar from the unavoidably adhering syrup (uncrystallisable sugar), in the process of the *clairsage*, as it is called with a French term, and the ordinary processes of refining could not entirely be dispensed with. It is curious to read in the specification as something new the use of the mixture of acetic acid and alcohol for determining the percentage of real—i.e., crystallisable—sugar met with in any sample of raw sugar. Fifteen years ago this mixture was in constant use in many Continental refineries and beet-root sugar works—(so at least in Belgium, Northern France, and in Holland; Silesia, of which Breslau is the metropolis, is a country where both sugar manufacture—from beet-root—and refining is largely carried on, and it is almost certain that many years ago the same mixture was applied there for the identical purpose)—where the optical sugar test by Soleil's or other similar apparatus was also applied at the same time. It ought to be borne in mind that both the alcohol and acetic acid must be absolute for this purpose.

The practical refiners of sugar know very well that, by means of the centrifugal machine and the application of a strong, quite concentrated solution of best refined sugar, raw sugar may be entirely freed from the molasses adhering to it; while, owing to the use of a concentrated solution of sugar, nothing but the uncrystallisable sugar is removed, the solution of sugar is being concentrated as to refuse taking up any more crystallisable sugar.

I am, &c., DR. A. ADRIANI.

* See page 92, column 2, line 27 from the top.

Numerical Relations of Equivalent Numbers.

To the Editor of the CHEMICAL NEWS.

SIR,—“Few would call chemistry a mathematical science” (*vide* letter by “*Studiosus*,” p. 95 of the CHEMICAL NEWS); and, therefore, I protest against the use of the term “law” when applied to a few cases of mathematical relation between atomic numbers. If there really be such a law as the “law of ‘*Studiosus*’” (how it sounds!)—viz., that the atomic numbers are multiples of 8—then the agreements should be many and the exceptions few. But is not the reverse the case rather? In proof of his law, “*Studiosus*” enumerates fifteen elements whose atomic numbers are exact multiples of 8. But how many elements are there whose atomic numbers are not multiples of 8? Of sixty-one atomic numbers, seventeen approximate within two units to exact multiples of 8, and thirty cannot by any twisting be called multiples of 8 more than of any other number. So that, to prove this law, fifteen cases out of sixty are adduced, the remaining forty-five being exceptions.

“*Studiosus*,” in his first moments of pardonable ecstasy at having discovered a “law,” does not appear to have perceived this disproportion between agreements and exceptions. Subsequent reflection, however, convinced him that he must trim some of the forty-five exceptional numbers in order to make them tally with his “law.” Certainly it is necessary at times to make a sacrifice in the cause of law and order; but only fancy (Cl) 35.5 being reduced to 32 as the nearest multiple of 8; (N) 14 being raised to 16, Fl (19) having 5 added, or (As) 75 diminished by 3. “*Studiosus*” seems to defend this wholesale system of alterations on the ground that these poor wretches of atomic numbers are “merely the result of experiment,” and therefore some “amount of latitude” must be allowed. Certainly, “latitude” must be allowed with a vengeance if the numbers above quoted and others are to be forced into obedience to this “law.” I wonder what would be the result of using “*Studiosus*’” lawful numbers in analysis, instead of those derived from actual experiment!

“*Studiosus*” complains, though unjustly, when Mr. Newlands shows, at p. 59, that there is no such law at all. It is only fair, however, to point out that what ought to be condemned, and what Mr. Newlands himself does condemn—viz., approximations and allowances—are just the means which Mr. Newlands, to a large extent, employs in his own tables of “relations,” or how else could he make (p. 59) Zn₆₅ a mean between Mg₂₄ and Cd₁₁₂, or V₁₃₇ a mean between Mo₉₆ and W₁₈₄?

The fact is, there has been a great deal of nonsense written about these “laws” and “relations.” (But then you know, Mr. Editor, it is much easier to sit down and make laws for these numbers than to verify the numbers themselves.) Of course it cannot be denied that some of the relations which have been pointed out are interesting enough, but in many cases they are mere rubbish. Given 70 numbers ranging from 1 to 240, and allowing any amount of “latitude,” to find a law with these conditions, who couldn't discover a law as good as the “law of ‘*Studiosus*?’”—I am, &c. J. NOBLE, F.C.S.

Royal Arsenal General School, Woolwich, August 30.

ANSWERS TO CORRESPONDENTS.

A. O. Z.—They could not be removed by chemical means. They must be rubbed down.

O. H. A.—See front advertisement page.

C. R.—By adding an alkaline carbonate, unless it is present in the form of carbonate, in which case oxalate of ammonia. The “cheapest” method need not be considered.

R. S.—The detention and estimation of humic acid in water is a very difficult matter. It is supposed to exist in combination with an alkali, and is precipitated on the addition of an acid. You will find a short account of the process in Noad's “Chemical Manipulation and Analysis.”

Received.—Dr. Muspratt, with thanks.

and lime, ammonia and baryta, lead, and mercury are also coloured precipitates. Double salts similar to the above are prepared by replacing the ammonia by potash or soda.

The above compounds, and the preparation of salts derived from a well-defined compound, place beyond doubt the existence of an iso-alloxanic acid isomeric with alloxanic acid, so as to establish the following parallel series:—

Alloxan $C_8H_2N_2O_8$	Modified alloxan $C_8H_2N_2O_8$
Alloxanic acid $C_8H_4N_2O_{10}$	Iso-alloxanic acid—(?)
Alloxanate of ammonia, colourless salt— $C_8H_2(NH_4)_2N_2O_{10}$	Iso-alloxanate of ammonia, red precipitate— $C_8H_2(NH_4)_2N_2O_{10}$
Alloxanate of silver, white salt— $C_8H_2Ag_2N_2O_{10}$	Iso-alloxanate of silver, red precipitate— $C_8H_2Ag_2N_2O_{10}$
Alloxanate of ammonia and silver—(?)	Iso-alloxanate of ammonia and silver, blue precipitate— $C_8H_2(NH_4)AgN_2O_{10}$

The study of these various compounds gives the true explanation of the reaction which distinguishes uric acid. We know that by evaporating this acid to dryness with nitric acid, we obtain by dessication a red colour which increases by the addition of a few drops of ammonia, and giving the reaction characteristic of uric acid. This colour is considered to result from the formation of murexide or purpurate of ammonia. The foregoing researches prove that this coloration is due, first and principally to red, modified, anhydrous alloxan, then, after the addition of ammonia, to iso-alloxanate of ammonia. —*Bulletin de la Société Chimique*, vi., 445.

The Action of the Amalgam of Sodium on Alkaline Nitrates and Nitrites in Solution, by M. P. DE WILDE.

THE amalgam of potassium was for the first time employed in organic chemistry by M. Melsens, to effect the transformation of trichloroacetic into acetic acid.

The amalgam of sodium has since been advantageously substituted for that of potassium, and Melsens's reaction has proved to be remarkable for the generality of its application. In fact, most of the bodies in which chlorine or bromine have been substituted are regenerated by the action of this energetic reducer.

Some recent remarkable studies in organic chemistry have shown that the amalgam of sodium could also provoke direct additions of hydrogen.

It is to be regretted that this agent, which has furnished such admirable results in the hands of MM. Kekulé, Würtz, Lourenço, and others, has as yet been used in mineral chemistry only for the production of the amalgam of ammonium.

Guided by this thought, and by the possibility already proved of transforming nitric acid into ammonia by nascent hydrogen, I tried the action of the sodium amalgam on nitrates and alkaline nitrites.

The amalgam used in my experiments contained from 3 to 4 per cent. of sodium. It is in the form of hard, brittle cakes, which are kept from contact with air.

By putting fragments of this amalgam in cold saturated solutions of nitrate of potash or soda, a violent disengagement of gas takes place, lasting but a few seconds, the temperature rising considerably. The experiment is easily made in a glass funnel with the end sealed, the gases directly collected in receivers reversed in the liquid.

The same phenomena are observable when these solutions are diluted with twenty times their volume of

water; likewise when concentrated or diluted solutions of nitrite of potash are used.

In all the instances quoted the quantity of ammonia formed is very minute. Searching for this body with all possible care, we were unable to prove its presence in concentrated solutions; diluted solutions contain hardly a trace.

By pouring sulphuric acid into the solution of a nitrate treated by the amalgam, nitrous vapours are disengaged, which shows that a part of the nitrate has been transformed into nitrite.

With the amalgam of sodium the solution of nitrate of ammonia behaves in the same way as the nitrates and nitrites of potash and soda. No amalgam of ammonium is produced; the gaseous disengagement is very intense; an ammoniacal odour is developed, evidently due to the action of the soda in the undecomposed nitrate, and the ammonia of the nitrate decomposed.

Experimenting under special conditions—that is to say, by putting an excess of amalgam in contact with an alkaline nitrate or nitrite—a notable quantity of ammonia is produced.

To attain this result with greater certainty, pour a greatly diluted solution of nitrate or nitrite drop by drop on fragments of amalgam, so as not to cover it completely. In this case there is again a violent disengagement of gas, and at the same time a very decided ammoniacal odour.

The reaction is considerably moderated by the use of an amalgam containing about 1 per cent. of sodium and 15 to 20 per cent. of zinc; very little gas is disengaged, and almost all the nitrogen is transformed into ammonia.

I have also observed that by adding a sufficient quantity of amalgam to the solution of nitrate, the whole of the nitrogen is eliminated, and the solution contains only alkali.

This fact is very easily proved, for if a trace of nitrate or nitrite remained, the simultaneous addition of sulphuric acid and sulphate of iron would develop a brown tint.

To determine the composition of the gases disengaged in these reactions they have been submitted to a careful examination.

These gases all sustain combustion more or less well, less, however, than oxygen and protoxide of nitrogen. They detonate with hydrogen.

Left in contact, cold, for twenty-four hours with a stick of phosphorus their volume remains undiminished. They contain then no free oxygen.

Mixed with oxygen and gas from a battery, the volume does not diminish by detonation. No hydrogen then is present.

Hence it follows that these gases are mixtures of nitrogen and protoxide of nitrogen.

Analysis of these gases by M. Bunsen's eudiometer gave the following results:—

2. Gas proceeding from a saturated solution of nitrate of soda—

	I.	II.
Protoxide of nitrogen.	66.17 volumes	65.95
Nitrogen	33.83 „	34.05
	100.00 „	100.00

2. Gas proceeding from a saturated solution of nitrate of soda, diluted with five volumes of water—

	I.	II.
Protoxide of nitrogen.	58.18 volumes	57.75
Nitrogen	41.82 „	42.25
	100.00 „	100.00

3. Gas proceeding from a concentrated solution of nitrite of potash—

	I.	II.
Protoxide of nitrogen.	39.35 volumes	38.77
Nitrogen	60.65 „	61.23
	100.00 „	100.00

4. Gas proceeding from a concentrated solution of nitrite of potash, previously diluted with five times its volume of water—

Protoxide of nitrogen	55.37 volumes
Nitrogen	44.63 „
	100.00 „

5. A special examination of the same gas for hydrogen showed that it contained none.—*Bulletin de la Société Chimique*, vi., 403, 64.

Researches on Sulphuretted Combinations of Uranium,
by M. ADOLPHE REMELE.

THE following are the principal results of an investigation I have pursued this winter in M. Rivot's laboratory at the Ecole des Mines:—

Sulphide of Uranyle.*— $[\text{U}_2\text{O}_2]\text{S} + \text{Aq.}$ —Hardly anything has hitherto been known of the nature of compounds formed by the action of a solution of alkaline sulphide on salts of uranium. By heating strongly metallic uranium in sulphur vapour, there is obtained, according to most chemists, a sulphide corresponding to the formula UrS , and Rose obtained an analogous substance by passing a current of sulphide of carbon in vapour over the intermediate oxide of uranium heated to redness†; but the reactions of the wet way, though very precise, remain as yet unexplained.

In most chemical treatises it is stated that the precipitate given by hydrosulphate of ammonia in a solution of uranium is sulphide of uranium, having probably a formula analogous to that of the salt of uranium employed. H. Rose was the first to throw a doubt on this opinion; he considered the precipitate in question, on account of a circumstance I will indicate further on, as a mixture of protoxide of uranium and sulphur. Neither of these suppositions are correct.

By pouring excess of hydrosulphate of ammonia into an aqueous solution of nitrate of uranium, a brown precipitate is produced, soluble to a considerable extent in excess of the reagent, and rendering the liquid almost black. On washing, the precipitate alters rapidly, becoming first orange, then light yellow. I have ascertained that the final product of this transformation is hydrated sesquioxide of uranium. For the matter remaining after very prolonged washing disengages water but not ammonia on calcination; it dissolves completely in hydrochloric acid, without giving out sulphuretted hydrogen, and the solution presents all the characteristics of salts of sesquioxide.

After numerous experiments I found a means of collecting the brown precipitate produced by the hydrosulphate of ammonia. This very simple method consists in dissolving nitrate of uranium in alcohol, and precipitating in the alcoholic liquid. Under these circumstances the liquid remains clear, and the precipitate is unalterable in the air; it may be washed with alcohol diluted

with a little water, and then dried in a vacuum on caustic potash.

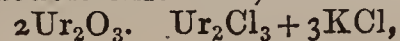
Numerous analyses of the substance thus prepared, which has all the characteristics of a defined compound, show that it contains, besides a certain quantity of sulphide of ammonium, just one equivalent of sulphur and two equivalents of uranium. To ascertain its chemical composition it is necessary to ascertain in what state the uranium is present.

These are the properties of this substance. When precipitated in a solution of nitrate of uranium in water heated to 40 or 50 degrees in presence of hydrosulphate of ammonia it decomposes into a mixture of protoxide of uranium and sulphur, and the opaque liquid regains its transparency‡; on boiling it with water it gradually forms a mixture of hydrate of protoxide of uranium and sulphur; lastly, treated by hydrochloric acid sheltered from the air it yields a green solution of uranium, which gives with ammonia a brownish precipitate of hydrated sesquioxide.

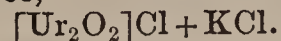
These reactions prove that protoxide of uranium pre-exists in the compound, and that all the uranium is in this state. Moreover, the direct weight has led me approximatively to the same result; having decomposed a given weight of the substance in a sealed tube at about 230° , I found that 63 per cent. of uranium had absorbed 2.18 per cent. of oxygen, passing to the state of green oxide (Ur_3O_4). The brown body is consequently a combination of two equivalents of protoxide of uranium with one equivalent of sulphur.

This composition, which at first appears strange, is satisfactorily explained when we recall M. Peligot's admirable labours on uranium. Here I will merely refer to his hypothesis as to the constitution of salts of uranium. It is well known that the sesquioxide of this metal, contrary to all known sesquioxides, forms with one equivalent of various acids, salts possessing all the properties of neutral salts; as yet no one has succeeded in preparing salts containing three equivalents of acid with one equivalent of oxide. To account for this anomaly, M. Peligot admits the existence of a radical formed of two equivalents of uranium and two of oxygen, and playing the part of a simple metal. Now, all is clear and simple; the sesquioxide, Ur_2O_3 , becomes a monoxide $[\text{Ur}_2\text{O}_2]\text{O}$, and with this there is naturally joined one equivalent of acid to form a neutral salt.

This hypothesis receives powerful support from the nature of the compound generally called oxichloride of uranium. Uranium forms no sesquichloride, but in place of it a combination containing the elements of two equivalents of sesquioxide and one equivalent of sesquichloride of uranium. It is a very remarkable fact that this oxichloride forms well-defined double salts with alkaline chlorides. But how is this? By adopting M. Peligot's theory, we have, instead of the oxichloride, a simple chloride, monochloride of uranyle (the name of the radical Ur_2O_2). There is nothing to prevent the latter forming double chlorides; and instead of



we have, for instance,—



But it seems to me that the body which I have examined furnishes yet more conclusive proofs of the justness of M. Peligot's opinions. Its formula may be written in two ways: $2\text{Ur}_2\text{O}_3 \cdot \text{Ur}_2\text{S}_3$; or, again, $[\text{Ur}_2\text{O}_2]\text{S}$. If the first formula represent the true constitution of

* The first part of the present memoir forms the subject of a note presented through M. Peligot to the Academie des Sciences at the meeting of April 18.

† M. Peligot believes it to be impossible to form in this way a combination of uranium and sulphur. Besides, the latter reaction never gives products the characteristics of which resemble those of ordinary sulphides.

‡ This curious fact well explains H. Rose's opinion that the brown body consisted of a mixture of protoxide of uranium and sulphur. The extreme solubility of this body in acids is a conclusive proof that it cannot contain free protoxide.

the compound—if it really is an oxisulphide—there ought then to be a pre-existing sesquioxide of uranium.

But how is it, then, uranium being so easily oxidised, that the substance, decomposed in presence of hydrosulphate of ammonia by the aid of heat, produces only protoxide and sulphur? There can be no doubt that the protoxide pre-exists; and as there are two equivalents of it which combine with one equivalent of sulphur, the only rational explanation seems to be to attribute to these two equivalents of protoxide of uranium the part of a radical.

Thus we have to do with a monosulphide of uranyle $[\text{U}_2\text{O}_2]\text{S}$, analogous to chloride of uranyle; and it will be seen further on that, as the latter combines with alkaline chlorides, the first may combine with the sulphides of the same metals.

The composition indicated is shown by the following numbers:—

Uranium	79.0
Oxygen combined with uranium	10.5
Sulphur	10.5
	<hr/>
	100.0

Besides, sulphide of uranyle contains a considerable proportion of water. The material which has served for most of my analyses gave, in 100 parts, 80.3 of sulphide of uranyle, 1.7 of monosulphide of ammonium, and 18 parts of water.

Insoluble in absolute alcohol, sulphide of uranium is partially soluble in pure cold water, to which it imparts a slight brown tinge; but this solution gradually decomposes, and the whole of the uranium is deposited in the state of hydrated sesquioxide or uranate of ammonia. All moderately strong acids, even when diluted with much water, very easily decompose brown sulphide; the combination is almost immediately destroyed, so that two thirds or three-fourths of the sulphur separate in a free state, under the form of small greenish-yellow flakes; very little sulphuretted hydrogen is disengaged.

Freshly-prepared sulphide of uranyle is of a beautiful chocolate brown colour; it is then probably combined with a determinate proportion of sulphide of ammonium, perhaps with that which would lead, for sulphuranylate of ammonia, to the formula corresponding to uranate of ammonia. The first would be $2[\text{Ur}_2\text{O}_2]\text{S}.\text{NH}_4\text{S}$; the second being $2[\text{Ur}_2\text{O}_2]\text{O}.\text{NH}_4\text{O}$. The existence of a real combination is so much the more probable that the substance, even after undergoing entire decomposition by washings in a very large quantity of water, still throws off sulphide of ammonium, which dissolves the free sulphur separated at the same time.

In the air this sulphide constantly disengages vapours of hydrosulphate of ammonia, and at the same time its colour changes to greenish brown. The proportions of sulphide of ammonium found in different products by analyses were always smaller than that indicated by the above formula. It seems impossible to free the substance entirely from volatile sulphide.

Sulphide of uranyle may enter into combination with the sulphides of fixed alkaline bases, and it then gives place to sulphuranylates very little soluble in water and alcohol. These compounds are very slightly stable; nevertheless I have prepared several of them in a pure state. Those I have at present studied contain sulphide of potassium, sodium, and barium. They are easily decomposed by acids with disengagement of sulphuretted hydrogen.

(To be continued.)

TECHNICAL CHEMISTRY.

Eighth Report of the Commissioners of Inland Revenue.

THE Report of the Commissioners of Inland Revenue contains the usual Report from the Principal of the Laboratory. It is much too long for us to print entire, but some parts will have an interest to most of our readers.

The Report starts with some remarks on the alteration of the amount of work done in the laboratory since the equalisation of the duties on coffee and chicory. By this the necessity for examining some thousands of samples of coffee was removed, and hence we find that whereas in 1862 the excise chemists analysed 5088 samples of coffee, in 1863 they only examined 25 samples.

The extended importations of wines, however, has brought a large increase of work from the Customs department, and as this work has proved of a more difficult nature than the detection of chicory in coffee, the reporter is at pains to show that although there has been a diminution of 2722 in the total number of articles analysed, there has, nevertheless, been a considerable accession of work.

With regard to the wines imported, it is remarked:—

“Within the past year, the Customs have adopted very stringent measures for the purpose of suppressing the obnoxious practice, which has been increasing during the last few years, of importing fabricated wines. Ninety-four of these so-called wines were analysed within the period to which this Report refers, the examination of which demanded much care and experience on the part of the analysts.”

We must express our regret that the writer has not given us some idea of the composition of these fabricated wines, with the names they pass under, so that the public may be on their guard.

Our readers are aware, from our notices of past Reports, that one duty assumed by the chemist to the Excise is the instruction of a limited number of Excisemen in chemistry. On this subject the Report says:—

“The systematic instruction of young officers in chemistry and other subjects pertaining to the laboratory continues, I may venture to say, to be satisfactory. Ten of these students were examined in June last by Dr. Hofmann, nine of whom passed with much credit through a rather severe examination in both theoretical and practical chemistry. Since the introduction, in October, 1858, of the present system, the laboratory has received forty-nine students, many of whom, when they return to the surveying branch of the service, carry with them, in addition to their scientific knowledge, studious habits and a power of rigorous reasoning and close observation, which cannot fail, I think, to be in the end valuable to the service. The ten officers now under instruction will, I trust, in their final examination, attain the praiseworthy position arrived at by their predecessors.”

Of the special subjects of investigation, the first mentioned is tobacco. In the last Report it was said that the Irish manufacturers were in the habit of adulterating their Cavendish and roll tobacco with liquorice. This adulteration was nearly suppressed by the discovery of a satisfactory mode of detecting it, and the reporter believes that the adulterant is now seldom illicitly used, at which no one will be much surprised when they read that the “Manufactured Tobacco Act of 1863” allows the use of liquorice and other innoxious matters under certain regulations. A personal inspection of a large proportion of the tobacco manufactories of this country

during the past year has assured the principal chemist that the tobacco trade was never in a more healthy state than at present. It appears, however, that out of 100 samples examined during the past year thirty-one were adulterated; nineteen with liquorice, six with cane sugar, two with cabbage leaves, two with ground pimento in small quantity, one with chalk, and one with common salt.

The principal adulterant of snuff appears to be lime.

"The law permits the use of lime water in the manufacture of high-dried snuffs, such as Irish and Welsh, but it does not state what proportion of lime shall be present in the water, although there can be little doubt that a perfectly clear solution of lime in water was meant. Many manufacturers, however, assert that such a solution is useless in the manufacture of the snuffs in question, and persist in the use of what may be termed 'lime wash,' or a thick mixture of undissolved lime and water. Several unsuccessful attempts have been made within the last two years to suppress the very gross practice, which is still growing, of using such a mixture; and, from reasons which I have laid before the Board, I have come to the conclusion that until the use of lime in the manufacture of snuff is absolutely prohibited, the fraud can never be crushed, and that even the obtainment of a conviction will always be very uncertain. It has been generally understood that lime was essential in the preparation of high-dried snuff; but I have recently caused a fine specimen of such snuff, made by an eminent firm in Ireland, to be analysed, the result being that no more lime was present than what may be found in normal American tobacco; and I have reason to believe that the same firm strenuously opposed the legalising the use of lime water, and still maintain that lime, even in small quantity, deteriorates the quality of the snuff. Under these circumstances it becomes a matter for consideration whether the permission to employ lime in the manufacture of snuff should not be withdrawn.

"The vicious form of adulteration now under notice is almost entirely confined to the North of Ireland, where it appears the habit is very prevalent amongst the females employed in the linen and other factories, of taking snuff highly charged with lime, and which is known as 'white snuff;' and the manufacturers allege, in extenuation of their dishonest practices, that no other description of snuff is acceptable to their customers; apparently forgetting that they themselves have, by their long continued illicit practices, engendered the habit which they now seek to bring forward as a plea for their fraudulent transactions. I have lately had submitted to me several samples of snuff obtained from manufacturers in Belfast, in which it is impossible to say, from a mere inspection, whether lime or tobacco predominates; and I have received information, which I believe to be true, from respectable members in the trade, that some manufacturers do not even care to use a mixture of lime and water, but actually grind up dry lime with the tobacco in the process of manufacture.

"The evil in question appears to demand, both upon social and fiscal considerations, an immediate remedy. It can never be suppressed under the existing law, and, as I have before observed, the only effectual course to be adopted is the entire prohibition of the use of lime in the manufacture of snuff; and I have reason to believe that the obnoxious practice is distasteful to many manufacturers, who, however, feel compelled in self-defence to adopt it, and that its continuance is mainly due to the unscrupulous operations of one or two members of the trade.

Samples of Snuff Analysed.

Year.	Number of Samples.		
	Genuine.	Adulterated.	Total.
1863	32	25	57

"The illicit ingredients found in the adulterated samples comprised the ground husks of rice, dyewoods, orris root, cereal starch, peroxide of iron, and an inordinate amount of lime.

Pepper.—There is reason to believe that this commodity is still adulterated extensively either by the grinders of, or the wholesale dealers in, the article. Within the period to which this Report refers, 30 samples of pepper have been analysed, 18 of which were adulterated, the adulterants being the starch and husks of rice, wheat starch, linseed meal, and in one instance ground pine wood. In 17 of the samples ground rice, varying in quantity from 2 to 15 per cent., was present, while the husk of rice, which was found in 16 samples, ranged in quantity from 1 to 10 per cent.

A seizure, made in the provinces, of adulterated pepper led to the examination, within the past year, of the stocks of pepper in the possession of two firms in London largely engaged in the trade, the result being that my assistants who examined the stocks felt it their duty to seize about one ton and a-half of ground pepper heavily adulterated with rice husks, the whole of which was forfeited to the Crown and destroyed. In these instances I am of opinion that the dealers were innocent of the fraud, and that the grinder alone was the offender; but still they cannot be exculpated from blame, for whilst they insist upon the return of an unreasonable percentage of ground produce from the public grinders, they must expect that the loss of weight which unavoidably occurs in grinding will be made up by illicit materials. In the two cases under notice the proportion of the adulterating ingredients present in the several parcels of pepper seized varied from about 10 to 15 per cent., so that the revenue was being defrauded of at least one-tenth of the duty chargeable on the commodity.

Samples of Pepper Analysed.

Year.	Number of Samples.		
	Genuine.	Adulterated.	Total.
1863	12	18	30

Chicory.—Seeing that the sophistication of coffee has long been an established practice, it is not surprising that certain unscrupulous dealers have, within the past year, attempted the adulteration of chicory, as the inducement to commit that fraud is now equal to that which has for many years led to the adulteration of coffee. Penalties have been imposed upon five dealers for committing the fraud in question, the adulteration consisting of from 15 to 20 per cent. of ground roasted peas and the husks of mustard seed, whilst in one sample sago starch was found.

During the year 25 samples of coffee and chicory have been analysed, 20 of which proved to be genuine.

Beer.—Twenty-six samples of beer and of materials found in the possession of licensed brewers have been analysed, and of these 20 were found to be illicit; the prohibited ingredients being, in 14 samples, grains of paradise, one of these samples containing, in addition, tobacco; in two others coculus indicus was present in large and dangerous quantities; two samples contained capsicum; and the remaining two proto-sulphate of iron. Generally, the prohibited materials employed in the adulteration of beer are not injurious to health, and it is but seldom that instances come under my notice in which poisonous substances have been used, the object of the fraudulent brewers or retailers of beer being more

to increase the bulk of their goods than to render the beer stupifying by the addition of noxious materials. Still, there can be little doubt that the practice of adulterating beer with poisonous matters, such as tobacco and coculus indicus, is more prevalent than might be inferred from the small number of detections made, as the fraud is difficult to discover unless the offender be caught in the act of committing it. Considering, therefore, this circumstance, and the abominable character of the offence, I am of opinion that it would be only just to the community to make public the names of those persons convicted of adding coculus indicus or other deleterious substances to beer brewed for sale; and I feel no hesitation in stating that the two instances of the use of the dangerous drug in question occurred in the neighbourhood of Wirksworth, in Derbyshire, and that many of the detections of the use of grains of paradise were also made in the same district; and I may further say that experience of many years has led me to the conclusion that the adulteration of beer with drugs, as distinguished from the mere dilution or increasing of the bulk of the article, is more prevalent in the Midland Counties and the West Riding of Yorkshire than in any other parts of the kingdom.

Malt.—The adulteration of malt with ungerminated grains appears to be steadily decreasing.

Wood Naphtha.—Nothing has transpired since the date of my last Report to lead me to suspect that the revenue is endangered by allowing methylated spirit to be used duty-free in the arts and manufactures. It is possible that the spirit in its impure state may to some small extent be illicitly used, seeing that the present duty on spirits affords a strong incentive to the commission of the fraud; but it would be too much to expect that, while all other duties are always in some degree evaded, this one should be exempt from the same evil. There can, however, be no doubt that any loss which the revenue may sustain through the improper use of methylated spirit is insignificant when compared with the benefit which accrues to the manufacturing interests of the country from the permission to use such spirit duty-free.

From the character of the samples which have been forwarded to my department within the past year under the supposition that they were illegal, it would appear that the attempts to apply methylated spirit to purposes not contemplated by the Legislature are directed more to the use of the spirit in medicinal preparations than to its introduction as a beverage. The samples referred to comprised five of hyponitrous ether, one of laudanum, one of tincture of rhubarb, one of wood spirit, three of methylated spirit which had been attempted to be purified, two samples termed "Indian brandee," one termed "Indian whiskey," and one "Hollands whiskey." The four last-named samples might, from the names given to them, be supposed to be imitations of brandy and whiskey, which, however, they did not in the least resemble, as they were simply very impure hyponitrous ether, highly sweetened, and made from methylated spirit, the "brandee" being coloured. They were very nauseous, and would never be drunk as a beverage except by persons having a most vitiated taste; and the price at which I am informed they are sold—namely, from 2d. to 3d. per ounce, or at the rate of from 26s. 8d. to 40s. per gallon—appears to confirm the statements made by those who prepare and vend the articles, that they are purchased by the poor classes, not as substitutes for potable liquors, but as specifics for many complaints which they are advertised to cure. I may add that the sale of these

compounds appears to be confined to certain localities in Lancashire and Cumberland.

The wood spirit used in the methylation of alcohol is invariably tested in the laboratory as to its fitness for the purpose for which it is intended, and during the past year ninety-five samples have been so examined.

Miscellaneous Samples.—The number of samples difficult to classify examined within the past year is 360, of which 135 were from the Customs and 225 from the Excise. The samples comprised wines, spirits, cordials, essences made from wood spirit, cordialised malt extract, cane and starch sugars, syrups, "dandelion coffee," extract of chicory, "coffee finings," "breakfast beverages," dextrine, glycerine, medicinal preparations, cattle food, and sheep wash.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE VI.

DELIVERED ON THURSDAY EVENING, APRIL 28, 1864.

Flesh, its chief constituents, boiling and roasting. *Animal black*, its manufacture and applications. Various methods of preserving animal matters. Employment of animal refuse in the manufacture of *prussiate of potash*. A few words on the decay of organic matters, and their fermentation and putrefaction.

It will be easily understood, by those who have done me the honour of attending this course, that this last lecture must touch upon a variety of topics, in order to give an idea of some of the applications which animal matters receive, and which yet remain to be discussed.

Flesh.—M. Chevreul, in 1835, and Baron Liebig, in 1845, examined the changes which flesh undergoes when placed in contact with hot and cold water; and the following table, taken from Liebig's interesting work on the chemistry of food, will give you an idea of the composition of flesh:—

	Cold water.	Action of boiling.
Soluble	... .. 66	{ Coagulated albumen... 29.5 Gelatine. 6.0 In solution 30.5
Insoluble	... .. 164	Fibres & membranes 164.0
Fat	... .. 20	
Water	... .. 750	
	1000	

Liebig and Chevreul further succeeded in isolating, of the 30 parts soluble in water, some of the following substances:—

Kreatine	... ..	C ₈ H ₉ N ₃ O ₄ + 2 H O
Kreatinine	... ..	C ₈ H ₇ N ₃ O ₂
Sarcosine	... ..	C ₆ H ₇ N ₃ O ₄
Inosinic acid	... ..	C ₁₀ H ₆ N ₂ O ₁₀
Lactic acid	... ..	C ₆ H ₅ O ₅ + H O
Guanine (Scherer)	... ..	C ₁₀ H ₅ N ₅ O ₂
Xanthine (Strecker)	... ..	C ₁₀ H ₄ N ₄ O ₄
Glycocoll	... ..	C ₄ H ₅ N O ₄
Leucine	... ..	C ₁₂ H ₁₃ N O ₄
Osmazome	... ..

The most important mineral salts in flesh are the acid phosphate and lactate of lime, and, according to Fremy, the acid phosphate of potash and chloride of potassium. The above statement shows that flesh is a most complicated substance, and it is easy to conceive that this must be so, when it is remembered that it is derived from blood, of which it contains a large amount; but a most interesting and curious fact is that, whilst blood is rich in salts of soda and poor in salts of potash, in flesh the relative

proportion of these salts is directly reversed. Another interesting fact is the small amount of solid matter contained in flesh, and also the small amount of nutritive matter it yields to water under the most favourable circumstances. I repeat "the most favourable circumstances," for when meat is placed in boiling water the 3 per cent. of albumen it contains is coagulated, closing the vessels of the flesh, and preventing all further exit of the fleshy fluids, and such should be the case when meat is intended to be eaten as boiled meat and is properly cooked; but when the object in view is to extract the whole of the matter soluble in water, as in the preparation of beef tea, then the meat should be cut in small pieces, and brayed in a mortar with water, the whole then thrown into clean linen and pressed. The juice of the flesh so obtained should then be carried just to the boil, again passed through the strainer, and after the addition of a little common salt will be ready for the patient. Beef tea, even prepared by this process, which is certainly the best to my knowledge, contains, as the table above shows, but a small quantity of nutritive matter, there being only a little gelatine and a small proportion of the other substances named above. Chevreul attributes the odour of beef tea and meat soups to osmazome, and Liebig to kreatine; in fact, Liebig considers kreatine to be one of the essential substances characterising the aroma of various kinds of flesh. Liebig during his researches on this substance succeeded in obtaining from—

Fowls' flesh	...	...	...	3.21	of kreatine.
Ox heart	...	...	...	1.37	„
Pigeon	...	...	...	0.82	„
Beef	...	...	...	0.69	„

Further he observed, that the flesh of wild animals contained a much larger proportion of kreatine than those which were confined; for instance, that there was six times as much in the flesh of a wild fox as in that of a tame one. Allow me to say a few words on the properties of this curious substance, which presents itself in the form of moderately large white rectangular prisms, having a pearly lustre, soluble in water, insoluble in alcohol; and although this substance is neutral, it is converted when heated with hydrochloric acid into another solid crystallised substance called kreatinine, which possesses strong alkaline properties. When kreatine, instead of being treated by an acid is acted upon by baryta, it is converted into an acid compound called inosinic acid. Liebig ultimately succeeded in finding these substances, as well as another called sarcosine, in various animal secretions. I shall not take up more of your time by discussing the chemical properties of these substances, but merely state that they enable us to distinguish real soup tablets from spurious ones. For this purpose a solution of the tablet in cold water should be made, when, if genuine, it will give a precipitate with chloride of zinc, whilst the spurious one, which contains gelatine but no kreatine, will not do so. Another reaction is, that the pure article will yield 85 per cent. of its weight to alcohol, whilst the imitation will only yield about five.

Preservation of meat and animal substances.—A low temperature is most favourable to the preservation of flesh and other animal substances; it will not enter into putrefaction, the best proof of which is that elephants in a perfect state of conservation have been found in Siberia buried in ice, where they have doubtless existed for many thousands of years. It is also well known that the inhabitants of polar regions preserve their meat fresh by burying it in snow, and I mentioned an instance in one of my previous lectures, viz., the preservation and bleaching of sturgeons' bladders on the banks of the Volga. A high state of dessication or dryness also contributes powerfully to the prevention of decay. Thus in Buenos Ayres and Monte Video, meat is cut into thin slices, covered with maize flour, dried in the sun, and consumed largely, under the name of Tassago or Charke, by the inhabitants of the in-

terior, and also by the black population in Brazil and the West Indies. Further, dried meat reduced to powder is used by travellers in Tartary and adjacent countries, and I may add that of late years meat biscuits have been extensively consumed by the emigrants having to travel from the United States to California and the West Coast generally. It is stated that six ounces per diem of this meat biscuit will maintain a man in good health throughout the journey. A remarkable instance of the preservation of animal matter by extreme dessication is related by Dr. Wefer, who states that in 1787, during a journey in Peru, he found on the borders of the sea many hundreds of corpses slightly buried in the sand, which, though they had evidently remained there for two or three centuries, were perfectly dry and free from putrefaction. Although it is not within the scope of these lectures to describe the preservation of vegetable matters, still I cannot refrain from mentioning the interesting method adopted by MM. Masson and Gannal, by which, as you are doubtless aware, vegetables are preserved in the most perfect manner. Their process is most simple, as it consists in submitting the vegetables for a few minutes to the action of high pressure steam (70 lbs. to the square inch), then drying them by air heated to 100°, when, after compression by hydraulic pressure, they are made into tablets for sale, and when required for use it is only necessary to place the tablets for five hours in cold water, when the vegetable substances swell out to their former size and appearance and are ready for cooking. As the presence of oxygen or air is an essential condition of putrefaction, the consequence is that many methods have been invented to exclude that agent, or rather, as I shall show at the end of this lecture, the sporules or germs of cryptogamic plants or animals, which are the true ferments or microscopic source of fermentation and putrefaction. Permit me to describe concisely some of the methods proposed; and I believe that one of the best processes for excluding air was that invented by Appert, in 1804. It consists in introducing the meat or other animal substance with some water into vessels which are nearly closed; these are then placed in a large boiler with salt (which raises the boiling point of the liquor), and the contents of the vessels are kept boiling for about an hour, so as to exclude all air, and destroy, by the high temperature, all the sporules or germs of putrefaction they may contain, when they are hermetically closed. M. Chevalier Appert has improved this process in placing the prepared vessels in a closed boiler, by which means he raises the temperature (by pressure) to 234°, which effects the same purpose more rapidly and economically. To give you an idea of the extent of this trade, I may state that M. Chevalier Appert prepared above 500,000 lbs. of meat for the French Army in the Crimea. I am aware that many modifications have been applied to this process, but I shall only mention that of Mr. G. M'Call, who adds to the previous principle of preservation a small quantity of sulphite of soda, well known to be a powerful antiseptic. The beautiful specimens now on the table, which have been kindly lent to me by Messrs. Fortnum and Mason and by Mr. M'Call, will satisfy you of the applicability of the above-named methods for the preservation of meat and other animal substances. But before concluding this part of my lecture, I must add that the preservation of animal and vegetable substances by the exclusion of air and cryptogamic sporules is also effected by other methods than those above described; for instance, they are imbedded in oil, or in glycerine, as suggested by Mr. G. Wilson, or into saccharine syrups. I should not forget to mention that several plans have been proposed for protecting animal matter by covering their external surfaces with coatings impermeable to air. Two of the most recent are the following:—M. Pelletier has proposed to cover the animal matter with a layer of gum, then immersing it in acetate of alumina, and lastly in a solution of gelatine, allowing the whole to

dry on the surface of the animal matter. The characteristic of this method is the use of acetate of alumina, which is not only a powerful antiseptic, but also forms an insoluble compound with gelatine, thus protecting the animal matter from external injury. Mr. Pagliari has lately introduced a method which is stated to give very good results. It consists in boiling benzoin resin in a solution of alum, immersing the animal matter in the solution, and driving off the excess of moisture by a current of hot air, which leaves the above antiseptics on the animal matter. It is scarcely necessary to mention the old method of using smoke arising from the combustion of various kinds of wood, except to state that in this case it is the creosote and pyroligneous acid which are the preservative agents. The preservation of animal matter by a very similar action is effected by the use of carbolic acid, a product obtained from coal tar. It is much to be regretted that this substance, which is the most powerful antiseptic known, cannot be made available for the preservation of organic substances intended for use in arts and manufactures, no cheaper or more effective material can be found. For example, I have ascertained that one part of carbolic acid added to five thousand parts of a strong solution of glue will keep it perfectly sweet for at least two years, and probably for an indefinite period. Also, if hides or skins are immersed for twenty-four hours in a solution of one part of carbolic acid to fifty of water, and then dried in the air, they will remain quite sweet. In fact, hides and bones so prepared have been safely imported from Monte Video. From these facts and many others with which I am acquainted I firmly believe that this substance is destined, within a few years, to be largely used as an antiseptic and disinfectant. I need hardly speak of the power of chloride of sodium, or common salt, in preserving animal matters, and it is highly probable that the interesting process described to you on the 13th April, by Mr. J. Morgan, for the employment of salt, is likely to render great service in preserving animal food from putrefaction. But with regard to the feasibility of its use in Monte Video and Buenos Ayres, I cannot offer an opinion, as it depends upon so many local circumstances which it is impossible to appreciate here. Messrs. Jones and Trevethick displayed at the last Exhibition some meat, fowls, and game preserved by the following process, which received the approbation of the jurors. Meat is placed in a tin canister, which is then hermetically closed, with the exception of two small apertures in the lid. It is then plunged into a vessel containing water, and after the air has been exhausted through one aperture by means of an air pump, nitrogen is admitted through the second aperture; and the alternate action of exhausting the air and replenishing the nitrogen is kept up until the whole of the air has been removed. The nitrogen in its turn is exhausted, and sulphurous acid gas admitted. The two apertures are then soldered up, and the operation is completed. As I consider the action of carbon on animal matters rather as a case of oxydation than of preservation, I shall refer to that subject further on, and shall, therefore proceed to consider the employment of certain animal matters not yet alluded to during this course of lectures, such as the flesh of dead animals not used as food, and those other parts of their carcasses which have not been applied in any of the processes already described. The greatest part of these refuse matters are used for producing animal black, which differs from bone black, referred to in my first lecture, being used in the state of impalpable powder, whilst bone black or char is composed of small hard grains. The manufacture of animal black is generally carried out by introducing into horizontal retorts connected with a coil or condenser, and with an exit pipe for the gases, some of the animal matters mentioned; on the application of heat decomposition occurs, the oily matters distil and condense in the worm, and constitute what is called Dippel's oil, formerly much used in the

art of currying certain classes of leather; water also distils, charged with a variety of ammoniacal salts, which are generally converted into sulphate of ammonia for agricultural purposes. As to the gases, they are usually ignited and burnt to waste. The carbonaceous mass which remains in the retort is removed, and ground to powder in a mill with water, allowed to settle, and, lastly, dried and sold under the name of animal black. Its chief uses are in the manufacture of blacking and printing ink. Another manufacture which consumes a large quantity of animal refuse, especially the horns, hoofs, &c., of too inferior a quality to be used for the purposes described in my first lecture, is that of the yellow prussiate of potash, a most important salt, for it is extensively used in calico printing, silk and wool dyeing, and in the manufacture of the pigment called prussian blue, for gilding silver, copper, and other inferior metals; and lastly, it is the source from which cyanide of potassium is procured, a substance much employed in the art of photography. Let me now call your attention to the manufacture of prussiate of potash, the greatest portion of which is prepared at the present day still by the old process devised by Dr. Woodward, F.R.S., in 1724. It consists in introducing into large cast-iron pots American pearlash, melting it, closing the vessel, and then setting the mass in motion by means of a revolving shaft. At this period of the operation hoofs, horns, and other animal refuse, are introduced in small quantities at a time. Under the influence of heat and of the alkali, the nitrogen of the organic matters splits into two parts, one part combining with the hydrogen to form ammonia, which escapes, whilst the other portion unites with the carbon, producing cyanogen, which remains combined with the potassium of the potash. After several hours the operation is considered to be completed, and the melted mass is run out into small cast-iron receptacles; when cool these are placed in large vats with water, and a jet of steam is introduced, and the whole is kept on the boil for several hours, when the cyanide of potassium is partly decomposed, giving rise to carbonate of potash and to cyanide of iron, for not only has a portion of the iron of the melting pots been attacked and combined with the mass, but a certain quantity of iron filings have been used during the operation. However, two parts of the cyanide of potassium combine with one part of cyanide of iron, and the result is that a double cyanide, called ferro-cyanide of potassium, or yellow prussiate of potash, is formed. The liquors are then allowed to clear by standing, and the aqueous solution is evaporated until a pellicle appears on its surface, when it is allowed to cool, and the salt is deposited on strings which have been passed through the crystallising vat, and which facilitate the crystallisation of the prussiate salt. In consequence of the large amount of animal matter used as compared with the quantity of prussiate obtained, this salt has always commanded a good price in the market, and has induced many eminent chemists to try to devise cheaper processes for obtaining it. To attempt here to give merely an outline of these various proposed plans would involve so much technical description as would occupy far too much time for this lecture, but I would recommend those interested in this branch of manufacture to read the learned account given by Dr. A. W. Hofmann, in his report on "The Chemical Products in the last Exhibition," page 57, where they will find the process of M. Gauthier-Bouchard for obtaining salts of cyanogen from the ammoniacal waters of gas works; those of Mr. R. T. Hughes and Messrs. Bramwell, of Newcastle, for the conversion of nitrogen of the atmosphere into cyanide of potassium; that of M. Kamrodt, for decomposing ammonia by carbon carried to a high temperature; and, lastly, that of MM. Margueritte and De^e Sourdeval, for producing cyanogen from the nitrogen of the atmosphere and fixing it by means of barium. This latter process seems to be highly commended by the learned reporter to whom I have referred.

I must not, however, omit to mention the scientific and interesting process devised by M. Gelis, and based on the chemical reaction which ensues when bisulphide of carbon is mixed with sulphide of ammonium. Yellow prussiate crystallises in large crystals belonging to the octohedral system, composed, as before stated, of two parts of cyanide of potassium, 2CyK , and one of iron, $\text{CyFe} + 3$ of water or HO . This salt is freely soluble in water, but is insoluble in alcohol, and when mixed with weak vitriol and heated gives rise to prussic acid, which distils, and may be used either as a violent poison or, in qualified hands, as a most valuable therapeutic agent. When ferrocyanide of potassium is heated with several times its bulk of concentrated sulphuric acid, instead of yielding prussic acid, as above, it gives rise to a poisonous gas, called oxide of carbon, which burns with a beautiful blue flame, and which we have all seen burning in some fireplaces when the combustible matter has lost all its volatile constituents and nothing remains but a red incandescent mass. When chlorine is passed through a solution of this salt chloride of potassium is formed, and the yellow prussiate is converted into red prussiate or ferricyanide of potassium, composed of $3\text{CyK} + 3\text{Fe}_2\text{Cy}_3$. When heated with peroxide of mercury, potash, peroxide of iron, and cyanide of mercury are produced, the latter being a most violent poison. To produce Prussian blue on silk with this salt, all that is required is to dip the silk in a slightly acidulated liquor containing a persalt of iron, and when the silk is washed and mordanted, it is dipped in a weak acidulated solution of yellow prussiate of potash, when it assumes a beautiful blue colour due to the formation of Prussian blue. To dye wool it is necessary to pass it through a boiling bath composed of yellow prussiate, muriate of tin, and a small quantity of sulphuric acid. Prussian blue is gradually formed, and fixes itself on the fibre. To produce blue on calicoes, a solution of yellow prussiate of potash is made, to which is added some tartaric acid and muriate of tin. This mixture, after having been properly thickened, is printed on the calico, and then submitted to the action of steam, the Prussian blue so produced being fixed on the cotton fibre by means of the oxide of tin, resulting from the decomposition of the salt employed.

Nothing is more simple than to gild or silver metals by means of ferrocyanide of potassium, or to cover iron and other metals with copper. To obtain a gilding liquor, it is only necessary to take 1000 parts of water, adding to it 100 parts of yellow prussiate of potash, 10 parts of chloride of gold, and 1 part of caustic potash. Each of these should be added successively, and the whole of the liquor carried to the boil and filtered. It is then ready for gilding silver or brass objects, when properly attached to the pole of a galvanic battery. The silvering liquor is made by substituting for the chloride of gold, in the above process, ferrocyanide of silver, prepared by adding nitrate of silver to a solution of ferrocyanide of potassium, the white precipitate resulting being washed and added to the liquor intended for silvering. For covering zinc or iron with copper it is simply necessary to substitute the ferrocyanide of copper for that of silver. Ferrocyanide of potassium, as above stated, is also employed for the manufacture of Prussian blue, which was accidentally discovered by Diesback, in 1718, by adding alum, containing iron, to the ammoniacal liquors sold to him by Dippel, which were produced, as already stated above, during the distillation of animal refuse. These liquors, being rich in cyanide compounds, yielded with the salt of iron of the alum, Prussian blue. At the present day Prussian blue is manufactured by different processes, but they are all based on the principle of mixing various salts of iron with red or yellow prussiate, when double cyanides of iron (or Prussian blues) are produced.

(To be continued.)

ACADEMY OF SCIENCES.

August 29.

THE first communication read was a very important memoir by M. Claude Bernard, entitled "*Experimental Researches on Opium and its Alkaloids*." This eminent physiologist was led to experiment on the effects of all the alkaloids of opium from noticing great and unexpected variations in those effects when the alkaloids were employed to facilitate experiments on living animals. He found, in fact, that the six principal alkaloids—morphine, narceine, codeine, narcotine, papaverine, and thebaine—each produced a particular effect, but the action may be classed under three heads—the soporific, the exciting or convulsive, and the poisonous action. The relative power of the alkaloids to produce these effects is indicated by their position in the following table:—

Soporifics.	Excitants.	Poisons.
Narceine	Thebaine	Thebaine
Morphine	Papaverine	Codeine
Codeine	Narcotine	Papaverine
	Codeine	Narceine
	Morphine	Morphine
	Narceine	Narcotine

Thus it is seen that three only produce purely soporific effects, but even these vary greatly in character and degree. Morphia, for example, produces a stupefying effect. The animal is scarcely insensible, but it becomes a sort of living machine, and will remain in any position in which it is placed. The sensitive nerves are extremely dull, and the extremities may be strongly pinched without disturbing the animal. When roused by a noise it seems frightened, but quickly relapses into narcotism. As the animal awakens it has a haggard look, and the hinder extremities seem partially paralysed, so that it walks like a hyæna.

The effects of codeia are essentially different. The animal is tranquil, and seems to be in calm sleep, but he is at the same time very excitable; a slight noise wakes him up, and he runs away. The sensitive nerves are much less affected than by morphia, and no paralysis is observed when the animal awakens.

Narceia seems to produce the combined effects of morphia and codeia, and appears to be the most strongly soporific principle in opium. The animal sleeps more profoundly, but is not so much stupified as with morphia; and at the same time is not so excitable as when under the influence of codeia. It quickly returns to its natural state, and on awaking is neither frightened nor savage.

All these effects have been confirmed by repeated experiments on all available animals, and they appear to be constant and invariable.

Coming to the poisonous effects of the alkaloids, the author informs us that thebaia is the most active poison. A decigramme of the hydrochlorate of this alkaloid injected into the veins of a dog killed it in five minutes; but it is stated that *two grammes* of hydrochlorate of morphia injected into the veins of a dog of the same size did not cause death. There must, we think, be some mistake here, *two decigrammes*, perhaps, are meant. Codeia stands intermediate as a poison.

Thebaine also stands first as the most powerful agent in producing convulsions.

The inquiry which M. Bernard has thus opened is very large and important, and will, no doubt, be followed out with all the skill and care for which he is distinguished.

M. Payen contributed a note "*On Pyroxylin and Pyroxam*." The author accounts for spontaneous combustions of pyroxylin by showing that pyroxam, or starch saturated with nitric acid, is much more unstable, and inflames at a lower temperature than pyroxylin. The fibres of linen sometimes contain amylaceous granules, and therefore pyroxylin prepared with it is unstable. The tubular cavities of cotton also contain fatty matters which may possibly affect the composition of the gun-cotton.

The author does not believe in a stable compound such as trinitrocellulose is described.

In a note "*On Carbonic Oxide*," Dr. Calvert clears up some differences between the experiments of Boussingault and Cloez and himself; he now shows that the amount of carbonic oxide formed when oxygen is in contact with an alkaline pyrogallate varies with the temperature.

A paper by M. Michaelson, "*On the Products of the Oxidation of Butylic Alcohol*," shows that when this body is treated with bichromate of potash and sulphuric acid, propylic and butylic aldehydes are produced, and also propionic, butyric, and carbonic acids.

A paper by Mayer, "*On some Ethers of Biatomic Alcohols*," describes the mode of formation and properties of the bibenzoates of propylene and amylene, and the bisalicylates of ethylene and propylene.

M. Lieben contributed a note "*On the Substitution of the Hydrogen of Ether by Chlorine, Ethyl, and Oxethyl*." The last name is applied by the author to the body C_2H_5O .

M. Caventon presented a note "*On Some Bromides, and a New Hydrocarbon of the Hexylic Series*." He has prepared various compounds of bromine with hexylene, and on heating bromated hexylene $C_6H_{11}Br$ with alcoholic solution of potash, formed a body, C_6H_{10} , isomeric with diallyle, to which he gives the name *hexoylene*.

NOTICES OF BOOKS.

International Exhibition. Jurors' Report on Class II. Section A. Industry of Manures.

(Continued from page 106.)

THE next section of this interesting Report is, as we have said, a remarkable one. It traces the course of events which have brought our manurial industry into its present remarkable phasis—a phasis which, it is said, "is purely transitional, and which marks the crisis of a momentous revolution, even now in the course of accomplishment." The events alluded to have their origin in the discovery of the steam-engine. One of the first effects of this discovery was to collect our population in large towns, located usually on rivers leading to the sea. In the earlier stage of this development the use of cesspools was in vogue, and much of the nightsoil produced found its way back to the land. But presently came epidemics, and doctors looking for the cause of these, found it in the cesspools; and forthwith engineers were called in, who effectively drained our towns, but polluted all our great streams and wasted all our manure.

The next great event, also distinctly traceable to the invention of the steam-engine, was the abolition of the corn laws. Protection abolished, "the cultivators of this cold Northern soil were exposed to the competition of rival food-growers, beneath warmer suns, the more prolific cornfields of the South. Upon this unequal competition the English territorial proprietors entered, as upon a struggle for life or death. Abundant manuring seemed at the outset their main, if not their sole resource; hence the rapid and prodigious development (already noted) of the guano trade; hence the multiplication of manurial products from every form of waste, as manifested in the patent records; hence the celebrated 'nitrogen theory' and the 'high-farming' system, to which allusion will presently be made; hence, lastly, that ransacking of the whole world for bones, so criminal in Liebig's view. But steam power, which has imposed upon the British cultivator this struggle for existence, brings him also the means of issuing victorious from the encounter." Steam pumps shall send our urban *ejecta* all over the country; the steam plough shall furrow the land twice as deep and thrice as fast as man and horse; and husbandry shall in time rise from the rank of a *handicraft* to that of a *manufacture*. And if steam could only control the elements and regulate the seasons, all would go well with the British corn manufacturer.

In the meantime, however, the application of town sewage to the land on an extensive national scale still stands adjourned; and, as our readers will see to-day, the matter has not been much advanced by the last Parliamentary commission which considered the subject.

The quantity and dilution of sewage constitutes the great difficulty of dealing with it. The principal contributor to this Report many years ago propounded the formula—"The rainfall to the river, the sewage to the soil," and thus suggested the separation of the surface from the house drainage. But this, in the case of London, is a matter of comparatively little importance, since the daily *ejecta* of each individual becomes diluted in the house with about thirty gallons of water. Whether sewage so dilute is of much use on corn lands, and whether in any case it could entirely replace the use of superphosphates and guano, is still, we believe, an open question. If we were entirely a grass-growing country, the solution of the question might not be difficult; but during a considerable portion of the year corn lands would require no irrigation, and what is to be done with the sewage in the meantime? A great waste, in fact, seems inevitable, unless we take Liebig's advice, and return to the cesspool system in some form or other, or to some system by which the natural manure may be spared the enormous dilution to which it is now subjected. This is the question to which our engineers must soon give their attention; and with our present knowledge of the means of disinfection and deodorisation we have little fear that the end may be accomplished without our being submitted to a "martyrdom of stench," or "the still fiercer martyrdom of blood pollution and loathsome pestilence which stench engenders."

The next part of the Report might have been omitted. There is no necessity in these days to argue against the supposed impracticability of distributing liquid manure all over the country. It is only necessary to show that the manure is worth the distribution, and the subsoil of England, at all events, would probably soon be piped for the purpose, just as the Report states Flanders is already honeycombed with tanks for the storage of liquid manure. But the manure stored in Flanders is not diluted like our own, and, if we do not mistake, it comes from cesspools.

(To be continued.)

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1031. Bounet Frederic Brunel, Brussels, Belgium, "Improvements in treating vegetable fibres, in converting them into pulp, in bleaching the same, and in apparatus employed therein."—Petition recorded April 23, 1864.

1177. James Roy, Liverpool, Lancashire, "Improvements applicable to self-acting mashing apparatus."—Petition recorded May 9, 1864.

1409. Edward Joseph Hughes, Manchester, Lancashire, "Improvements in dyeing and printing."—A communication from Charles Labuth, Paris, France.—Petition recorded June 7, 1864.

1867. Allen Dalzell, Edinburgh, "Improvements in the manufacture of colouring matter applicable to dyeing and printing."—Petition recorded July 26, 1864.

1949. Adolph Hermann Alvin Pflughaupt, Manchester, Lancashire, "Improvements in producing colour from aniline."—Petition recorded August 4, 1864.

2039. Charles François Darcagne, Upper Thames-street, London, "A new mode of treating or preparing the sorgho plants (*Holchus sorghum*) so as to render the fibre thereof useful in manufactures as a substitute for horsehair and otherwise."—Petition recorded August 16, 1864.

Notices to Proceed.

981. Hugo Levinstein, New Bridge Street, Blackfriars, "Improvements in the preparation of purple, violet, and blue aniline dyes."—Petition recorded April 20, 1864.

999. Henry Adrien Bonneville, Rue du Mont Thabor, Paris, France, "A new semi-fluid or solid product obtained by concentrating the saponaceous parts of the quillai tree."—A communication from Emeric de Werchin, Maubenge, France.—Petition recorded April 21, 1864.

1019. James Edward Duyck, Stamford Street, Surrey, "Improvements in distilling and purifying petroleum oils and other hydrocarbons, and in apparatus employed therein."

1021.—James Edward Duyck, Stamford Street, Surrey, "Improvements in treating petroleum and other hydrocarbon oils and fats or fatty bodies."—Petitions recorded April 22, 1864.

1073. Marc Antoine François Menmons, Rue de Dunkerque, Paris, France, "An improved apparatus for the capsulation of fluid medicines."—A communication from Jules Viel, Tours, France.

1076. Richard Hudson Smithett, Inner Temple, and John Davidson, Temple Street, Blackfriars, "Improvements in treating clay, artificial stone, metal, or other plastic or malleable material, to render it more suitable for constructive purposes."—Petition recorded April 29, 1864.

1732. John Forbes, Perth, N. B., "Improvements in distilling liquids, and in the machinery, apparatus, or means employed therefor."—Petition recorded July 12, 1864.

1994. Charles Lowe, Bradford, Lancashire, "Improvements in the manufacture of colouring matters."—Petition recorded August 10, 1864.

2076. Gerin Gabriel Boggio, Paris, France, "A new or improved process for extracting the oil contained in the flour of oleaginous seeds for distilling, rectifying, and evaporating volatile substances, for preparing volatile oils or essences and extracts for dyeing and medical purposes, for desiccating animal and vegetable alimentary substances, plants, roots, and flowers, and for ventilating."—Petition recorded August 23, 1864.

CORRESPONDENCE.

Dr. Schwarz's Process for Refining Sugar.

To the Editor of the CHEMICAL NEWS.

SIR,—The attack of Dr. Adriani on my process of sugar refining by means of alcohol and muriatic acid is evidently based upon wrong premises, which, with your permission, I will correct with as much brevity as possible.

Dr. Adriani asserts that alcohol and acetic acid were unsuccessfully tried for this purpose in Belgium in the year 1849. I am, of course, bound to believe his statement, but possibly the failure might be attributed to a deficient knowledge of the correct *modus operandi*. The fact of its being unsuccessful may account for my having no knowledge or record of it; the result, however arrived at, is totally at variance with the experiences of Mr. Dumas, who has adopted it for the estimation of sugar. Next, Dr. Adriani ventures to state that acetic acid is the only acid fit for this purpose. My experience, on the contrary, has convinced me that, good as the acetic acid may be, muriatic acid is preferable on a large scale, not only economically as to its cost, but also from its producing more readily the sugar crystals, and these in a more perfect condition.

The Doctor fears that the inflammability of alcohol might be an obstacle, which, if carried on in an open apparatus, as he seems to suppose, possibly might be attended with some risk; but even so, not so much as the varnish makers incur by the use of methylated spirits which they use at a high temperature, whilst economy, even more than danger from inflammability, conduces to

my using hermetically-sealed vessels, by means of which I recover the alcohol at a very small percentage of loss.

By my method not only is the percentage of loss of alcohol very small, but the quantity of alcohol applied is also reduced to a minimum, which will be better seen when compared with the method of Pessier, so much eulogised by the Academie of France, and which is worked on a large scale in that country; it involves the use of 500 to 600 per cent. of alcohol, being about thirty times as much as is required by my process. As to the recovery of the volatilised alcohol, I should feel obliged if Dr. Adriani would assist me to a better process than condensation by a cold water injector. I have, however, practically found it to answer the process very admirably.

Dr. Adriani pays me the personal compliment of assuming that I have not much practical knowledge of sugar refining. In reply to this, I beg to inform him that since the year 1848 I have been actively engaged in Silesia in numerous sugar refineries, as consulting chemist; also that the Society of German Sugar Refiners did me the honour of testing my process, under the superintendence of two of the most experienced sugar refiners, at their own costs and charges, which certainly evinced their sense of my judgment and experience, and which was confirmed by their satisfaction at the novelty and successful working of the process, and the correctness of my deductions, the whole of the crystalline portion of the raw sugar being recovered in a perfectly pure condition.

Dr. Adriani favours barytes as an agent for the utilisation of molasses. This process has been adopted in Russia, where the molasses are of little value, and been abandoned, as it was found that no fish, flesh, or fowl could live in contact with the refuse of the works.

Dr. Adriani fears the action of the acidulated solution of molasses upon the plant used in my process, but forgets that it would only be by great mismanagement that any free acid would be found in the solution, organic acid only being present. I have, moreover, left a piece of iron wire gauze in a mixture of muriatic acid and alcohol many days, and found scarcely a trace of iron in the solution.

With regard to the use of a saturated solution of sugar to free the crystals from the adherent molasses pure sugar must of necessity be used, and becomes so deteriorated by the molasses as to be recovered with difficulty, in a very inferior condition, and with considerable loss. In Germany instead of the saturated solution of sugar pure water is used, thus avoiding the loss of the sugar that has been already purified, but sacrificing a large percentage of crystalline sugar, both processes being alike in principle. The result of a trial by the Commission of the Society of Sugar Refiners of the last-mentioned process as compared with mine, is:—

By my process—89 per cent. of pure, dry, white sugar.
By above process—60 per cent. moist, sticky, white sugar.
With these results in favour of my process the Commission were highly satisfied, and with their testimony I trust your readers will be satisfied, if I have not succeeded in making a convert of Dr. Adriani.

I am, &c.

DR. SCHWARZ.

London, September 7.

MISCELLANEOUS.

Utilisation of Sewage.—The Select Committee appointed by the House of Commons to inquire into any plans for dealing with the sewage of the metropolis and other large towns, with a view to its utilisation for agricultural purposes, have published their report. Its chief points are as follow:—"The Committee has come to the conclusion that it is not only possible to utilise the sewage of towns by conveying it, in a liquid state, through mains and pipes to the country, but that such an undertaking

may be made to result in pecuniary benefit to the rate-payers of the towns whose sewage is thus utilised. That benefit may, in a few years, be greatly increased; for the amount of artificial manure is even at present insufficient, and the sources whence some of the most important are obtained will, in a few years, be exhausted. Other means of fertilising land must therefore be resorted to. The Committee, having examined the Chairman and Engineer of the Metropolitan Board of Works, are of opinion that more might have been done by that Board towards the profitable use of the sewage of London; and that the completion of the outfall sewerage of the metropolis ought, at the earliest possible moment, to be followed by the adoption of a system which may convert that sewage from a nuisance into a permanent and increasing source of agricultural fertility. Even if a pecuniary benefit were not to be secured, yet such a consideration should not deter local authorities from taking such steps as are possible to free rivers from pollution. There can be no doubt as to the injury which results from the practice of conducting sewage and other refuse matters into the rivers, from whence numerous towns, villages, and country populations derive their water supply. It is imperatively necessary that such a practice should be discontinued. No efficient artificial method has been discovered to purify, for drinking and culinary purposes, water which has been once infected by town sewage. By no known mechanical or chemical means can such water be more than partially cleansed; it is always liable to putrify again. Processes of filtering and deodorisation cannot therefore be relied upon to do more than mitigate the evil. Water which appears perfectly pure to the eye is sufficient, under certain conditions, to breed serious epidemics in the population which drinks it. Soils, however, and the roots of growing plants have a great and rapid power of abstracting impurities from sewage water, and rendering it again innocuous and free from contamination. Mr. Ffennell, the Chief Inspector of Fisheries, stated in his evidence that sewage water, in a putrifying state, is destructive to fish; a considerable increase in the amount of food for the people, and of revenue to the owners of rivers, would therefore result from purifying the rivers of the United Kingdom which are now contaminated by sewage and other matters. The removal of house refuse to the land would now be much easier and cheaper than it was formerly; because carriage by suspension in a liquid is the cheapest mode of transport. In many towns of Lancashire there are to this day numerous cesspits. This is the case with Manchester, where the local authorities expend about 20,000*l.* a year for emptying them and removing the contents to the land, and receive back 50 per cent. by the sale of the material. We recommend that the important object of completely freeing the entire basins of rivers from pollution should be rendered possible by general legislative enactment, enabling the inhabitants of such entire districts to adopt some controlling power for that purpose; but it should include a provision for compelling local boards to render the sewage of their districts innocuous by application to the land for agricultural purposes. The case of the valley of the Thames (where the purification of the river, which has been sought by the expenditure of enormous sums, is, to a considerable extent, counteracted by the increased discharge of sewage from towns higher up the stream) requires special and immediate attention."

Wave Length of the Thallium Ray.—Many years ago Mr. Fox Talbot discovered that when a continuous spectrum is examined by covering one-half of the pupil of the eye with a thin transparent plate, so as to modify that part of the pencil of rays on the side of the violet part of the spectrum, a number of transverse bands, alternately light and dark, appear to traverse it. Brewster discovered that these bands were not formed when the thin plate was placed on the side of the spectrum corresponding with the

red rays. It has since been discovered that these bands may be produced by interposing the thin plate in other portions of the path of the ray, besides putting it close to the eye. Baden Powell and Stokes have since studied the phenomena both experimentally and theoretically, and the latter physicist found that the effects were best produced by the partial immersion of a transparent plate in the liquid of a fluid prism. M. Bernard has lately studied these phenomena, and has arranged his apparatus in the following manner:—A ray of solar light passing through a narrow orifice falls on the slit of a spectroscope, the defringent plate being then placed between the aperture admitting the light and the slit of the spectroscope, and some adjustments and arrangements are made, into the detail of which we need not enter. In this manner M. Bernard is enabled to obtain a very luminous spectrum, and he has been led by an examination of the phenomena to the discovery, that through them he is enabled to obtain the length of the waves of any desired ray of light or spectrum line with much greater accuracy than by the ordinary diffraction method. In his memoir he has given the wave lengths of the seven principal rays of the solar spectrum, together with that of the ray A, which, owing to its faintness, has not yet been satisfactorily determined, and the green ray of thallium. Their values, expressed in millionths of a millimetre, are—

$$A = 760.6$$

$$Tl = 535.2^*$$

The diffringent plate of quartz is about a millimetre thick, and its thickness can be determined with absolute accuracy with the spherometer; and when it is remembered that between A and H there are for this thickness more than 700 interference bands, and that it is easy to estimate to the tenth of a band, it is seen that there are more than 7000 invariable points in this portion of the solar spectrum, and it is by reference to these that M. Bernard proposes to classify the rays of the alkaline metals and other interesting spectra. For this purpose he has constructed an apparatus which acts both as a spectroscope and a goniometer, and which enables the observer to measure to within 10" the indices, a knowledge of which is necessary to calculate the wave lengths.—*Quarterly Journal of Science*, No. III.

ANSWERS TO CORRESPONDENTS.

. All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

. In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10*s.* 8*d.*, by post, 11*s.* 2*d.*, handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* 6*d.* if sent to our Office, or, if accompanied by a cloth case, for 1*s.* Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

B.S.—The regulations are so varied that the best way is to obtain an introduction to some one connected with the University, and make the inquiry personally.

An Inquirer.—No doubt the same as other vegetable oils, principally low hydrocarbons.

Inquirer.—Received. Shall appear next week.

Students.—Wurtz's lectures will be continued as soon as Dr. Calvert's are concluded.

Erratum.—In the letter of Dr. Adriani, p. 120, last line but one, for "the solution of sugar is being concentrated," read "the solution of sugar being so concentrated."

* Dr. J. Müller (*Quarterly Journal of Science*, vol. i. p. 157) finds the length of the wave of the green thallium line to be 534.8 millionths of a millimetre.

ADDRESS TO STUDENTS.

IN the present number we again present our readers with a list of the Chemical Lectures and Classes for the ensuing Session. To many this may appear an unnecessary proceeding, but the experience of past years showed us that the information is appreciated, and proves useful. We need, then, offer no apology for continuing a practice thus sanctioned and approved.

On this occasion again we shall presume to offer but little in the way of advice. The study of chemistry is most often connected with that of some other pursuit—as medicine, pharmacy, or metallurgy—and when specially followed it is generally by gentlemen of mature years and fixed habits. Students of the former class must be left to their teachers, and for the latter any advice is clearly unnecessary.

There is one word, however, which cannot be too often repeated to students, and that is—"Persevere." "You have commenced," we may say, "the study of a science which is pre-eminently fruitful. No other offers such a boundless field for research; no other presents the same certainty of reward. The vast domain of inanimate nature lies before the chemist like a half-deciphered scroll. The great secrets of vital phenomena await the chemist for revelation. No single inducement to persevere is absent. Be the student ambitious of greed or fame, the earnest study of chemistry brings both within his reach. The pecuniary reward may be large, but there is a reward better worth having than riches. The discoverer of chloroform is more to be envied than the most successful patentee; and doubtless there are bodies yet to be discovered which will prove greater blessings to humanity than chloroform."

We need not repeat here the observations we made last year respecting the text-books of the science.

The commencement of the study of Chemistry is both easy and interesting; and it is not until advanced in the course that the student becomes perplexed by complex molecules and conflicting theories. Each lecturer adopts some particular view on classification and the constitution of bodies, and necessarily has but little time to discuss opposing theories. But in the course of reading the student is certain to meet with ideas which may be strange to him, and of which he may desire some explanation. It may be of use, then, to refer to Mr. Galloway's "Second Step in Chemistry" as a guide to the advanced student through the labyrinth of modern chemical theories. The chemist who shall reduce all these to one perfect and consistent system, it will be seen, is still wanting; but if he must yet be waited for, let us at least hope that he will be found among those who begin their studies this year.

There is one subject to which we may direct especial attention, since our notice is so often called to it by correspondents; and that is, the opportunities for obtaining chemical instruction in the evening. Some knowledge of chemistry is so often found to be desirable by those practically engaged in various occupations, that many are anxious to make use of the only time available to them for special studies. To those so circumstanced in London, we must point out the advantages which are offered by the evening classes at King's College, and the Birkbeck course at University College. The list of private teachers also contains the names of gentlemen who devote some evenings to practical instruction; and the provincial list includes classes which offer peculiar advantages.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Remarks on the Parabenzole Series, by A. H. CHURCH, M.A., Professor of Chemistry, Royal Agricultural College.

IN 1855 I first announced the existence of parabenzole in coal naphtha; in 1857 I published further details regarding the new hydrocarbon; and in 1859 I discovered a second member of the parabenzole series—namely, paratoluole. My experiments on these liquids will be found in the *Philosophical Magazine* for the years above named. My attention has been recalled to the subject by the researches of MM. Béchamp, Beilstein, and Naquet. A liquid contained in coal naphtha, which, it appears, M. Beilstein and Dr. H. Müller regard as xylol, has been stated by M. Béchamp to be new; and I am inclined to think that it is not the original xylol of M. Cahours, but paraxylol, a hydrocarbon, whose existence I surmised in the spring of last year. The xylol upon which M. Cahours worked he found to boil between 128° and 130° . I assigned to this liquid the boiling point 126.2° ; for this substance the name xylol should be retained. The xylol of M. Beilstein and Dr. H. Müller boils at 139° —the very point at which my paraxylol remains in steady ebullition.

From the "Researches on the Refraction, Dispersion, and Sensitiveness of Liquids," by Dr. Gladstone and the Rev. T. P. Dale, one may draw convincing arguments as to the independent existence of parabenzole, &c. The following table gives a few of the most important physical differences of the new series, as compared with that to which benzole belongs:—

Substance.	Boiling point.	Density.	Specific refractive energy.
Benzole . . .	80.8	.8667	5564
Parabenzole . .	97.5	.8469	5684
Toluole . . .	103.7	.8650	5478
Paratoluole . .	119.5	.8333	5658

In each case the para compound differs from the normal one in having a higher boiling point, a lower density, and a higher specific refractive energy.

A distinguished foreign chemist hazarded the conjecture, so I am told, that parabenzole was a mixture of benzole and toluole. I should very much like to know how the mixture of two indifferent hydrocarbons having nearly the same density could form a liquid having a very much lower density. Where no heat is evolved, where no action takes place, it is reasonable to infer that no contraction or expansion occurs. (I have determined this in the present case by direct experiment.) Add equal volumes of pure benzole and toluole, what is the density of the mixture? The mean of .8667 and .8650—namely, .8658. What is the density of parabenzole? .8469. Similar results are obtained with other mixtures of benzole and toluole: the mixtures are, of course, also totally different in their chemical and physical deportment from pure parabenzole.

The same observations apply to paratoluole, &c. My results sufficiently account for the discrepancies in the boiling point assigned to toluole. I have very little doubt that there are at least two isomers of each member of the benzole series; and there may be many more. A comparison of the boiling points of the three first members of the normal and of the para series may prove interesting.

	Difference.
Benzole 80.8 }	16.7
Parabenzole 97.5 }	
Toluole 103.7 }	15.8
Paratoluole 119.5 }	
Xylole 126.2 }	12.8
(?) Paraxylole 139.0 }	

I have formerly pointed out that a similar difference (115°C.) occurs between the isomeric turpentine. With reference to Dr. H. Müller's pseudo-cumole, I do not at present see its relation to any series: it is curious that its boiling point, 140.5, should be nearly identical with that of the same chemist's xylole, 139°.

I have accumulated during the last few years many interesting facts relating to the parabenzole series, which I hope to publish in a complete form before long.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Examiners in Chemistry.—Dr. Debus; Dr. Miller, King's College.

The University of London is not an educating body; it simply grants degrees. A knowledge of Chemistry is necessary for the Matriculation Examination.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and latent heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements, including their compounds as enumerated below—their chief physical and chemical characters—their preparation, and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen, Chlorine, Bromine, Iodine, Fluorine, Sulphur, Phosphorus, Silicon.

Combining proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable life upon its composition.

Combustion. Structure and properties of Flame. Nature and composition of ordinary Fuel.

Water—Chemical peculiarities of natural waters, such as rain-water, river-water, spring water, sea-water.

Carbonic Acid. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas. Sulphurous and Sulphuric Acids. Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

In the Examination for Honours the Candidate, not more than twenty years of age, who shall most distinguish himself in Chemistry will receive a Prize to the value of Ten Pounds in money or books.

DEGREE OF BACHELOR OF SCIENCE (B.SC.).

This recently-instituted Degree is conferred on Candidates who pass a satisfactory Examination in Mathematics, Mechanical and Natural Philosophy, Zoology, Animal Physiology, Geology and Palæontology, and Chemistry.

For the first examination of the Candidate a knowledge of Inorganic Chemistry only is necessary, including the following subjects:—

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical combination and Mechanical mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent numbers. Equivalent volumes. Symbolical notation. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen. Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Bibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal-gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a Class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre; Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of cast iron, wrought iron, and steel. Chromium. Cobalt. Nickel. Zinc. Cadmium. Lead. Manufacture of whitelead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony. Silver. Gold. Platinum.

Principal compounds of the metals with the Non-Metallic elements. Theory of salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

In the Examination for Honours the Candidate, not more than twenty-two years of age, who shall most distinguish himself in Chemistry and Natural Philosophy shall receive an Exhibition of Forty Pounds per annum for the next two years.

SECOND EXAMINATION FOR B.SC. DEGREE.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of empirical formulæ. Methods of controlling empirical formulæ. Determination of the equivalents of organic acids and bases; examination of products of decomposition; determination of the vapour density of volatile bodies.

Law of substitution. Compound radicals. Homologous series.

The Chemical history of the Cyanogen group. Cyanogen. Hydrocyanic acid. Cyanic acid and Urea. Fulminates. Cyanuric acid. Sulphocyanic acid. Chlorides of Cyanogen. Uric acid.

Amylaceous and saccharine substances. Fermentation. Alcohol, wine, beer, bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyde and Acetic acid and

their homologues. Anhydrides, simple and mixed. Compound ethers.

Diatomic Alcohols and their acids. Glycol and Oxalic acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and oily bodies. Saponification.

Vegetable acids. The principal.

Ammonia and its derivatives. Ammonium and Ammoniacal salts. Amides and Amines, their classification. The chief natural Organic Bases.

Colouring matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose, Vegetable fibrin, Albumin, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal fibrin, Albumin, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, putrefaction. Destructive distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

The Candidate, not more than twenty years of age, who in the Examination for Honours shall most distinguish himself in Chemistry and Biology will receive Fifty Pounds per annum for the next two years, with the title of University Scholar.

EXAMINATIONS IN CONNEXION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity. Inorganic Chemistry. Organic Chemistry. Geology. Mineralogy. Mining. Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Payments on results to certificated teachers. 2. Grants towards the purchase of apparatus, &c. 3. Public examinations in which Queen's Medals, Honorary Certificates, and Prizes are awarded, held at all places complying with certain conditions. On the results of these examinations the payment on results is made to the teachers.

Examinations for Certificates to teach any of the before-mentioned Sciences are held annually, commencing in the first week in November, at South Kensington. Examinations will also be held in Dublin and Edinburgh if five candidates register themselves for examination in Ireland and in Scotland. Any person whatever may attend this examination by sending in his name to the Secretary of the Science and Art Department before October 15, stating the subject or subjects in which he wishes to be examined. Certificates of three grades are given in each group and each subject. These certificates are only considered as simple records of the results of examination in the various sciences before mentioned, entitling the teacher to earn payments by successful teaching in the subjects for which he is certificated.

The Science and Art Department holds, through the agency of each Local Committee, in May of each year,

a public examination of all Science schools and classes in any locality throughout the United Kingdom which complies with the requisite conditions. On the results of this examination the payments are made to certificated teachers. Application for it must be made to the Secretary of the Science and Art Department before the end of March in each year, stating the number of persons and the subject or subjects in which they are to be examined. All registered students of Science classes under certificated teachers (except Science certificated teachers) are eligible to receive Queen's prizes and Queen's medals under the conditions hereafter mentioned.

The results of the May examination are classified under the following heads:—(1) first class, (2) second class, (3) third class, (4) honourable mention, (5) pass, and (6) failed. The names of the successful candidates, those under the first five heads, are published. The standard of attainment required may be raised from year to year. For the pass it is only such as will justify the examiner in reporting that the instruction has been sound, and that the students have benefited by it. Those who have obtained a higher degree of proficiency are classed as honourable mention, or as 3rd, 2nd, or 1st class, according to their merit.

To the 1st class are given Queen's prizes, consisting of books chosen by the candidates from lists furnished for that purpose. These prizes are unlimited in number, except that a student who has once received a 1st class Queen's prize cannot receive a prize in the same subject again. If such student should be again successful, his name will simply be recorded in the published list. To the 2nd and 3rd class certificates of merit recording the result of the examination are given.

The Queen's medals are, one gold in each group, one silver and two bronze in each subject, for competition throughout the United Kingdom. Only registered students of schools and classes under local committees can obtain medals. They cannot be taken by middle class students who are more than 17 years of age.

The payments to the certificated teacher are as follows:—He receives 1*l.* for every student of the industrial classes who has received forty lessons from him in a subject in which he is certificated, and passes in such subject of scientific instruction; 2*l.* for every one who is honourably mentioned; 3*l.*, 4*l.*, or 5*l.* for every one who takes a 3rd, 2nd, or 1st class. These students must have received forty lessons at least from the teacher since the last examination at which payment was claimed on their account. The forty lessons need not necessarily be all given in one year, but may extend over a longer period. 5*l.* is the maximum that can ever be claimed on account of the instruction of any one pupil in a subject.

A grant towards the purchase of apparatus, diagrams, &c., of 50 per cent. on the cost of them, is made to Science schools and classes in Mechanics' and similar institutions where the teacher is certificated, and to the extent of 5*l.* to other poor schools and classes.

The travelling expenses (second class railway fare and 10*s.* per diem personal allowance) of a candidate in attending the November examination are paid if he be successful in taking a certificate or in improving the grade of one he has already taken.

CHEMICAL LECTURES.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Chemistry.—Professor A. W. Hofmann, F.R.S.

The instruction in Chemical Science embraces—

1. A Course of Lectures on Experimental Chemistry with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

The Lectures are delivered in the Theatre of the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Hofmann. The Royal College of Chemistry having become the property of the Government, its spacious and well-furnished Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory student works independently, there being no classes. All operations are superintended by the Professor and his Assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

The charge for instruction in the Chemical Laboratory is 12*l.* for three months, 9*l.* for two months, and 5*l.* for one month.

Metallurgy.—Professor: Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

In the Lectures the processes of extracting metals from their ores are fully described, the chemical principles which they involve are explained, a detailed description is given of the furnaces and machinery employed, and, as far as reliable information can be obtained, the cost of production is stated. The illustrations consist of a very extensive series of specimens, diagrams, and models. Experimental demonstrations are occasionally introduced, but the time required for the satisfactory illustration by experiment of the chemical phenomena which occur in metallurgical process is generally so long as to make it impossible that in this respect the Lecturer of Metallurgy should follow the example of the Lecturer on Chemistry. In the Metallurgical Laboratory the students have the opportunity of conducting all necessary experimental investigations.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. The instruction comprises assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c., and the examination of ores and metallurgical products.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is 15*l.* for three months, 12*l.* for two months, and 7*l.* for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within the period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Chemistry, Metallurgy, Physics.

UNIVERSITY COLLEGE.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Daily, except Saturday, from 11 to 12.

Payment to the College, for a Half Term, 3*l.*; for the Term, 6*l.*; Perpetual, 9*l.*

The properties of the more important elements, and the methods of detecting and separating them, will be explained.

Processes for preparing chemical compounds useful in Medicine, or the manufacturing Arts will be examined in connexion with the principles upon which they depend. The construction and use of apparatus for experimental purposes will be shown.

The Subjects of the Course will be considered in the following order:—

Changes in the condition of matter by the action of Heat.

Light in its bearings upon Chemical Action, and in its application to Analysis.

Electricity as an agent of decomposition and change.

The atmosphere in its chemical and physical properties, and its functions in supporting vegetable and animal life. Explanation of the processes of eudiometric analysis, and demonstration of the regularity of combining volumes of gases.

The non-metallic elements, such as sulphur, iodine, &c., and the simplest of their compounds, as sulphuric acid, nitric acid, ammonia, &c.

The metals, and the most useful or remarkable of their compounds, in connexion with the laws of combination; also the constitution of salts, the atomic theory, &c. The tests for poisons will be explained and shown.

About thirty to forty Lectures will be devoted to Organic Chemistry, including the characteristic properties and metamorphoses of the chief groups of organic compounds, whether of animal or vegetable origin, such as the alcohols, fatty acids, alkaloids, acids of the bile, albuminous substances, &c.

Practical Chemistry.—Professor Williamson, Ph.D., F.R.S.

The Professor is aided in the direction of the Students by Assistants.

INSTRUCTION IN ANALYTICAL CHEMISTRY.

Birkbeck Laboratory.

The Course of Instruction in this department is intended for the assistance of Senior Students in the pursuit of all branches of Chemical Investigation, more especially Organic Research, and for the instruction of less advanced pupils in Elementary Analysis. It qualifies the Student for the application of Chemical Science to Agriculture, Medicine, and the Mechanical Arts; and arrangements have been made for giving practical instruction in Gas Analysis. The Laboratory and offices are fitted up completely with the most approved apparatus and utensils for experimental research, both for beginners and advanced Students. They are open daily from 9 a.m.

to 4 p.m. from October 3 until the end of July, with a short recess at Christmas and Easter.

Fee for the Session, 26*l.* 5*s.*; six months, 18*l.* 18*s.*; three months, 10*l.* 10*s.*; one month, 4*l.* 4*s.*, exclusive of the expense of materials. A deduction of 40 per cent. is made for Students who can attend only three fixed days per week.

The Gold Medal as a reward of merit for this Class will be given by the Council as usual.

ELEMENTARY CLASSES OF PRACTICAL CHEMISTRY.

Summer Course.—A Course of Fifty Lessons, of one hour each, on Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12, commencing the first week in May.

Fee 4*l.* This payment includes the cost of materials, &c.

Elementary Chemistry—Theoretical and Practical. Birkbeck Course.

Professor Williamson, F.R.S., and Dr. Russell.

A Course of Fifteen Lessons, of two hours each, on Tuesday and Friday, from the beginning of May to the end of June. Hours, from 7 to 9 p.m. Fee, including the cost of materials, &c., 2*l.*, for Masters of unendowed Schools and Ushers, and for persons engaged in Manufactures, or like pursuits.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject performed by the Students.

The first part of the Course is devoted to the study of non-metallic elements and compounds, their properties, and the best methods of distinguishing and separating them. In the second part the most important properties of the metals are studied. The ordinary methods of inorganic analysis are especially dwelt on, and solutions frequently given to the Class for analysis.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

KING'S COLLEGE.

CHEMISTRY.

Professor of Chemistry.—W. A. Miller, M.D., F.R.S.

Professor of Practical Chemistry.—G. L. Bloxam, Esq.

Demonstrator.—E. A. Hadow, Esq.

The Course commences with a View of the Forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal Compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures, of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *viva voce* and by written papers, are held at intervals during the course of the usual Lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the Class.

Third Year.—Students who have completed six Terms in this department are admitted to a Course of "Practical Chemistry," consisting of twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The Laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory Fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The Fee for the former is 1*l.* 11*s.* 6*d.*; for the latter, 2*l.* 2*s.* The Classes meet twice a-week.

MINERALOGY.

Professor.—James Tennant, Esq., F.G.S.

The Course commences with a description of the Physical and Chemical characters of Minerals in general. The principal simple Minerals are next separately considered, and the readiest mode of distinguishing them described.

The course of instruction includes a minute description of all the substances entering into the composition of Rocks, and of those minerals which are also used in the Arts; illustrated by an extensive collection of characteristic specimens, and diagrams of the principal crystalline forms, &c.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Dr. Odling, Monday and Friday, at half-past ten, and Wednesday, at ten. One course, 5*l.* 5*s.*

SUMMER SESSION.

Practical Chemistry.—Dr. Odling, Monday, Tuesday, Thursday, and Friday, from eleven to one. One course, 2*l.* 2*s.*

CHARING CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton. Tuesday, Thursday, and Saturday at ten. One session, 5*l.* 5*s.*

The Laboratory is open daily from ten to four p.m.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton. Monday, Wednesday, and Friday. One session, 2*l.* 2*s.*

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad. Tuesday, Thursday, and Saturday, at twelve. One course, 6*l.* 6*s.*

SUMMER SESSION.

Practical Chemistry.—Dr. Noad. Daily, at half-past nine. One course, 4*l.* 4*s.* Besides the usual course, instruction is given in the Laboratory daily by Dr. Noad.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Taylor. Tuesday, Thursday, and Saturday, at eleven. One course, 5*l.* 5*s.*

SUMMER SESSION.

Practical Chemistry.—Mr. Stevenson. Monday, Wednesday, and Friday, from ten to one. One course, 4*l.* 4*s.*

LONDON HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Letheby. Monday, Wednesday, and Friday, at half-past ten. One session, 7*l.* 7*s.*

SUMMER SESSION.

Practical Chemistry.—Dr. Letheby. Monday, Wednesday, and Friday, at a quarter-past eleven. One session, 2*l.* 2*s.*

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Matthiessen. Tuesday, Thursday, and Saturday, at a quarter-past ten a.m. One session, 5*l.* 5*s.*

SUMMER SESSION.

Practical Chemistry.—Dr. Matthiessen. Saturday, from nine to one. One session, 3*l.* 3*s.*

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at eleven. One session, 3*l.* 3*s.*

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch. Monday, Thursday, and Friday, at half-past eleven. One session, 5*l.* 5*s.*

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Tuesday, Thursday, and Saturday, at eleven.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Friday, at twelve; Saturday, ten to one.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. F. Dupré, Ph.D. Tuesday and Thursday, at three; Friday, at half-past ten. One course, 5*l.* 5*s.*

SUMMER SESSION.

Practical Chemistry.—Mr. F. Dupré. Tuesday and Thursday, at half-past nine. One course, 2*l.* 2*s.*

PHARMACEUTICAL SOCIETY OF GREAT
BRITAIN, 17, BLOOMSBURY SQUARE, W.C.LECTURES ON CHEMISTRY AND PHARMACY BY DR.
REDWOOD.

These Lectures will be delivered on Wednesday and Friday mornings, at half-past 8 o'clock.

Part 1.—Physics in relation to Chemistry and Pharmacy.

Part 2.—Chemistry of Inorganic Bodies.

Part 3.—Chemistry of Organic Bodies.

Fee.—For Registered Apprentices and Associates of the Society, 10*s.* 6*d.* For those not connected with the Society, 1*l.* 1*s.*

Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry

is under the direction of Dr. Attfield, assisted by Mr. Tilden. Fee for the entire session of ten months, 26*l.* 5*s.* The Laboratories are open from half-past 9 a.m. till 5 p.m. Students can enter at any period during the Session.

Two Jacob Bell Memorial Scholarships of 30*l.* each are open to competition annually in July.

ROYAL VETERINARY COLLEGE, CAMDEN
TOWN.

Professor.—Richard V. Tuson.

The Session commences October 3, and ends May 1.

Lectures on Chemistry and Veterinary Materia Medica on Monday, Wednesday, and Friday mornings, from eleven till twelve.

Practical Chemistry in the new Laboratory daily.

PRIVATE TEACHERS OF CHEMISTRY IN
LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W. —Chemical and Toxicological Class on Monday and Thursday evenings at 8. Laboratory open daily, except Saturdays.

Professor E. V. Gardner, F.C.S.—College of Experimental and Natural Philosophy, 44, Berners Street. Laboratory and Class Rooms open daily, morning and evening.

Evening Classes in connexion with the Department of Science and Art. The chemical lectures embrace courses on—I. Elementary Chemistry. II. Chemistry and Chemical Analysis. III. Organic Chemistry. IV. Geology and Mineralogy. A Laboratory Class also meets on two evenings in each week.

Mr. S. Highley, F.G.S., F.C.S., &c.—Scientific Educational Museum, 18, Green Street, Leicester Square, gives evening class instruction in the following educational courses:—Geology, Mineralogy, chemical and physical. Photography: its principles, practice, and applications, &c., &c.

Mr. Henry Matthews.—Laboratory, 30, Gower Street, Bedford Square, gives practical instruction in Chemistry in its application to Medicine, Agriculture, and Commerce. Laboratory open daily.

Dr. Medlock, 20, Great Marlborough Street, Regent Street.

Messrs. Nesbit, Lansdell, and Co.—College of Chemistry and Agriculture, 38, Lower Kennington Lane, S., Practical and Analytical Chemistry, Mr. J. Lansdell, F.C.S., 10 a.m. to 5 p.m.

Polytechnic Institution.—*Professor Pepper.*—A course of Lectures on the Chemistry of the Non-Metallic Elements will be given on Monday evenings during the present term.

Mr. A. P. Tarnier.—Laboratory, 3, Upper Baker Street, N.W., gives practical instruction in Chemistry in all its branches. The class of instruction is modified to suit the requirements of the student.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Lee's Reader in Chemistry.—A. G. V. Harcourt, M.A. A commodious Laboratory is attached to the new museum.

Scholarships of about the value of 75*l.* are obtainable at Christchurch, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

A Course of Lectures is delivered every Lent and Easter Term. The former course must be attended by candidates for the B.A. and LL.B. degrees. Candidates for Medical degrees must attend both courses.

There is no University Laboratory, but Sidney and St. John's Colleges have laboratories of their own. The latter is open to members of other Colleges when not fully occupied by its own.

A new and commodious laboratory, in connexion with Downing College, will shortly be ready for use.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—QUEEN'S COLLEGE.

Professor of Chemistry.—Alfred Anderson.

A Course of seventy Lectures on General Chemistry during the Winter Session, and a Practical Course for the Medical Boards in the Summer.

The Laboratory is open for daily instruction.

BIRMINGHAM.—SYDENHAM COLLEGE.

Professor of Chemistry.—Dr. A. Hill.

A Course of Lectures on General Chemistry during the Winter Session, and a Practical Course in the Summer.

The Laboratory is open for daily instruction.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. W. M. Williams.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

Lecturer on Chemistry.—Mr. Herapath.

BRISTOL SCHOOL OF CHEMISTRY.

Conducted by Dr. F. W. Griffin.

A Course of Lectures on General Chemistry, commencing in October, and Laboratory instruction throughout the year.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER, GLOUCESTERSHIRE.

Professor of Chemistry.—A. H. Church, M.A. Oxon., F.C.S.

Assistant Professor of Chemistry.—R. Warrington, Esq., jun., F.C.S.

The Session commences on August 3. Three Courses of Lectures are now being delivered: one Course on Agricultural Chemistry, by Dr. Anderson, of Glasgow, is just about to conclude; the other Courses, on Inorganic and Organic Chemistry, will be continued to the end of the Session. The Lectures are illustrated by experiments and specimens. Some stress is laid upon the knowledge of important minerals, of which, in the College Museum, there is a good collection, lately enriched by valuable additions presented by Capt. Guise.

The lectures are given at the following hours:—

Inorganic Chemistry.—Tuesday, 2 p.m.; Thursday (catachetical), 10 a.m.; Friday, 9 a.m.

Organic Chemistry.—Thursday, 3 p.m.; Friday, 2 p.m.

The Course of Instruction in Practical Chemistry in the Laboratory comprises Chemical Manipulation for the 1st Class, Qualitative Analysis for the 2nd, and Quantitative Analysis for the 3rd. The book used in these Classes is "Church's Laboratory Guide for Students of Agricultural Chemistry" (Van Voorst). Examples for the 3rd Class are selected from Agricultural Products and Materials. Students of the 4th Class who are

desirous of obtaining the College Diploma work in the Professor's private laboratory.

Chemical Manipulation.—Monday, 2 p.m.; Wednesday, 9 a.m.

Qualitative Analysis.—Tuesday, 10 a.m.; Thursday, 11 a.m.

Quantitative Analysis.—Thursday, 2 p.m.; Friday, 2 p.m.

The Autumn Session of the College divides October 6. The Spring Session will commence about January 8, 1865.

HULL AND EAST RIDING SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Walton.

The usual Courses for the Medical Boards.

LEEDS SCHOOL OF MEDICINE.

Lecturers on Chemistry.—Messrs. Scattergood and R. Reynolds.

The usual Courses for the Medical Boards.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes for instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of instruction in abstract and applied Chemistry will commence on Friday, September 30, at 8 p.m.

The Elementary Class meets on Friday evenings, 8.15 to 10.

A Class for the study of Organic Chemistry meets on Monday evenings, 8.15 to 9.30.

Practical Chemistry, Laboratory Course, Tuesday and Thursday evenings, from 8 to 10 o'clock.

Fees, payable in advance:—Elementary Chemistry, Friday, per Session, 1l. 15s.; 5s. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, 1l. 1s. per Session. Organic Chemistry, Monday, per Session, 10s. 6d. Practical Chemistry, Tuesday and Thursday, per Session, 2l. 2s.; 6s. per month. Including apparatus and material.

LIVERPOOL COLLEGE OF CHEMISTRY.

Principal.—Dr. Sheridan Muspratt.

Assistant.—Mr. M. Murphy.

Laboratory open daily, except Saturdays. The principal or his assistant is always present from 10 to 5.

A Course of Practical Chemistry for Medical Students in the Summer.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. J. B. Edwards.

The usual Courses for the Medical Boards.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. D. Stone.

The usual Courses for the Medical Boards.

A Laboratory is connected with the School.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNEXION WITH THE UNIVERSITY OF LONDON.)

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the elementary bodies and their most important inorganic compounds. Fee, 3l. 3s.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subject: Organic Chemistry, giving the properties and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee, 3*l.* 3*s.* For both classes, 5*l.* 5*s.*

Extra Class.—Wednesday, from 4 to 5 p.m.

Subject: Technological Chemistry.

The chemical principles involved in the most important chemical manufactures will be chiefly considered in this course. The subjects will be discussed as follows, and as far as time will permit:—

1. Production of Heat—Heat of Combustion—Combustibles—Coal.

2. Production of Light—Coal Gas—Measurement of Illuminating Power of Coal Gas—Distillation of Coal.

3. Water and Air, as regards their Sanitary and Technological Relations.

4. Processes concerned in the manufacture and application of the Alkalies.

5. Dyeing and Calico Printing.

6. Manufacture of Acids.

7. Manufacture of Glass and Porcelain.

Students attending this course must be acquainted with the principles of chemical science. Fee, 2*l.* 2*s.*

Analytical and Practical Chemistry.—*Laboratory Course.*—Professor Henry E. Roscoe, B.A., Ph.D., F.R.S. (The Professor is assisted in the instruction of the students by Mr. C. Schorlemmer.)

The aim of this course is to make the student practically acquainted with chemical science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole Sessions is, as a rule, necessary. It is very advisable that each laboratory student should attend or should have attended the course of lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except on Saturdays, when it will be closed at 1.30. Half an hour, from 1.30 until 2, allowed for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research. Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to provide his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, 21*l.*; ditto four days, 17*l.* 17*s.*; ditto three days, 13*l.* 13*s.*; ditto two days, 9*l.* 9*s.*; ditto one day, 5*l.* 5*s.*; Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole Session.

Special Fees for Shorter Periods.—For six months, six days per week, 17*l.* 17*s.*; five months, ditto, 15*l.* 15*s.*; four months, ditto, 13*l.* 13*s.*; three months, ditto, 10*l.* 10*s.*; two months, ditto, 7*l.* 7*s.*; one month, ditto, 4*l.* 4*s.* Students working only one day per week will ordinarily

be required to spend three hours of that time at a class which will be held on Saturday mornings, from 10.30 a.m. to 1.30 p.m.

Chemical Calculations.—Instruction in the methods of Quantitative Estimation in Chemistry, and intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

Laboratory students are recommended to attend and to answer the written exercises and the *viva voce* questions given in this class.

Free to all students attending the Laboratory Classes. Fee to others, 1*l.* 1*s.*

Dalton Chemical Scholarships.—Two, each of the annual value of 50*l.*, offered in alternate years, and tenable for two years. The scholarships are awarded for the best original investigations in chemistry prosecuted at the College, with a satisfactory written examination in Chemistry.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

NEWCASTLE SCHOOL OF MEDICINE.

(IN CONNEXION WITH THE UNIVERSITY OF DURHAM.)

Lecturers on Chemistry.—Dr. T. Richardson, and Mr. Browell.

The usual Courses for the Medical Boards.

The Laboratory is open every day from 10 to 5 for instruction in analysis, &c., &c.

SHEFFIELD MEDICAL INSTITUTION.

Lecturer on Chemistry.—Dr. Bingley.

The usual Courses for the Medical Boards.

SHEFFIELD SCHOOL OF PRACTICAL SCIENCE AND METALLURGY.

Professor of Chemistry, Metallurgy, and Geology.—James Allen, Ph.D., F.C.S.

The Sheffield School of Practical Science and Metallurgy affords a complete scientific and practical education to students who are destined to become civil, mechanical, or mining engineers, or manufacturers of any kind. Its object is thoroughly to discipline the students in the principles of those sciences upon which the operations of the engineer, metallurgist, or manufacturer depend.

The education is given by means of systematic Courses of Lectures, by Catechetical Class Instruction, by Practical Teaching in the Laboratory and Drawing-room, and occasionally by Field excursions.

The School of Practical Science and Metallurgy is conducted in the buildings of the Sheffield Collegiate School.

Fees.—Chemistry, course of 100 Lectures, 5*l.* 5*s.* Laboratory Practice, Chemistry.—One whole day each week, 4*l.* 4*s.* each term. Two whole days each week, 7*l.* 7*s.* each term. Three whole days each week, 10*l.* 10*s.* each term. Laboratory Practice, Metallurgy.—One whole day each week, 4*l.* 14*s.* 6*d.* each term. Two whole days each week, 8*l.* 8*s.* each term. Three whole days each week, 12*l.* 12*s.* each term. Each term extends over four months.

The charge for admission to the Lectures to working men will be 2*d.* each Lecture.

[The Scottish and Irish Schools are deferred until next week.]

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION.

Address* by Sir CHARLES LYELL, Bart., LL.D., D.C.L.,
F.R.S., &c., President. (Delivered before the Members of
the Association at Bath, September 14, 1864.)

GENTLEMEN OF THE BRITISH ASSOCIATION,—The place where we have been invited this year to hold our thirty-fourth meeting is one of no ordinary interest to the cultivators of physical science. It might have been selected by my fellow-labourers in geology as a central point of observation, from which, by short excursions to the east and west, they might examine those rocks which constitute, on the one side, the more modern, and on the other the more ancient records of the past, while around them and at their feet lie monuments of the middle period of the earth's history. But there are other sites in England which might successfully compete with Bath as good surveying stations for the geologist. What renders Bath a peculiar point of attraction to the student of natural phenomena is its thermal and mineral waters, to the sanatory powers of which the city has owed its origin and celebrity. The great volume and high temperature of these waters render them not only unique in our island, but perhaps without a parallel in the rest of Europe, when we duly take into account their distance from the nearest region of violent earthquakes or of active or extinct volcanoes. The spot where they issue, as we learn from the researches of the historian and antiquary, was lonely and desert when the Romans first landed in this island, but in a few years it was converted into one of the chief cities of the newly conquered province. On the site of the hot springs was a large morass, from which clouds of white vapour rose into the air; and there first was the spacious bath-room built, in a highly ornamental style of architecture, and decorated with columns, pilasters, and tessellated pavements. By its side was erected a splendid temple dedicated to Minerva, of which some statues and altars, with their inscriptions and ornate pillars, are still to be seen in the museum of this place. To these edifices the quarters of the garrison, and, in the course of time, the dwellings of new settlers were added; and they were all encircled by a massive wall, the solid foundations of which still remain.

A dense mass of soil and rubbish, from ten to twenty feet thick, now separates the level on which the present city stands from the level of the ancient *Aquæ Solis* of the Romans. Digging through this mass of heterogeneous materials, coins and coffins of the Saxon period have been found; and lower down, beginning at the depth of from twelve to fifteen feet from the surface, coins have been disinterred of Imperial Rome, bearing dates from the reign of Claudius to that of Maximus in the fifth century. Beneath the whole are occasionally seen tessellated pavements still retaining their bright colours, one of which, on the site of the Mineral-water Hospital, is still carefully preserved, affording us an opportunity of gauging the difference of level of ancient and modern Bath.

One of our former Presidents, Dr. Daubeny, has remarked that nearly all the most celebrated hot springs of Europe, such as those of Aix-la-Chapelle, Baden Baden, Naples, Auvergne, and the Pyrenees, have not declined in temperature since the days of the Romans; for many of them still retain as great a heat as is tolerable to the human body, and yet when employed by the ancients they do not seem to have required to be first cooled down by artificial means. This uniformity of temperature, maintained in some places for more than 2000 years, together with the constancy in the volume of the water, which never varies with the seasons, as in ordinary springs, the identity also of the mineral ingredients which, century

after century, are held by each spring in solution, are striking facts, and they tempt us irresistibly to speculate on the deep subterranean sources both of the heat and mineral matter. How long has this uniformity prevailed? Are the springs really ancient in reference to the earth's history? or, like the course of the present rivers and the actual shape of our hills and valleys, are they only of high antiquity when contrasted with the brief space of human annals? May they not be like Vesuvius and Etna, which, although they have been adding to their flanks, in the course of the last 2000 years, many a stream of lava and shower of ashes, were still mountains very much the same as they now are in height and dimensions from the earliest times to which we can trace back their existence? Yet, although their foundations are tens of thousands of years old, they were laid at an era when the Mediterranean was already inhabited by the same species of marine shells as those with which it is now peopled; so that these volcanoes must be regarded as things of yesterday in the geological calendar.

Notwithstanding the general persistency in character of mineral waters and hot springs ever since they were first known to us, we find on inquiry that some few of them, even in historical times, have been subject to great changes. These have happened during earthquakes which have been violent enough to disturb the subterranean drainage and alter the shape of the fissures up which the waters ascend. Thus, during the great earthquake at Lisbon in 1755, the temperature of the spring called La Source de la Reine, at Bagnères de Luchon, in the Pyrenees, was suddenly raised as much as 75° F., or changed from a cold spring to one of 122° F., a heat which it has since retained. It is also recorded that the hot springs at Bagnères de Bigorre, in the same mountain-chain, became suddenly cold during a great earthquake which, in 1660, threw down several houses in that town.

It has been ascertained that the hot springs of the Pyrenees, the Alps, and many other regions are situated in lines along which the rocks have been rent, and usually where they have been displaced or "faulted." Similar dislocations in the solid crust of the earth are generally supposed to have determined the spots where active and extinct volcanoes have burst forth; for several of these often affect a linear arrangement, their position seeming to have been determined by great lines of fissure. Another connecting link between the volcano and the hot spring is recognisable in the great abundance of hot springs in regions where volcanic eruptions still occur from time to time. It is also in the same districts that the waters occasionally attain the boiling temperature, while some of the associated stufas emit steam considerably above the boiling-point. But in proportion as we recede from the great centres of igneous activity, we find the thermal waters decreasing in frequency and in their average heat, while at the same time they are most conspicuous in those territories where, as in Central France or the Eifel in Germany, there are cones and craters still so perfect in their form, and streams of lava bearing such a relation to the depth and shape of the existing valleys, as to indicate that the internal fires have become dormant in comparatively recent times. If there be exceptions to this rule, it is where hot springs are met with in parts of the Alps and Pyrenees which have been violently convulsed by modern earthquakes.

To pursue still further our comparison between the hot spring and the volcano, we may regard the water of the spring as representing those vast clouds of aqueous vapour which are copiously evolved for days, sometimes for weeks, in succession from craters during an eruption. But we shall perhaps be asked whether, when we contrast the work done by the two agents in question, there is not a marked failure of analogy in one respect—namely, a want, in the case of the hot spring, of power to raise from great depths in the earth voluminous masses of solid

* We have omitted those portions of the President's Address which do not particularly relate to chemistry or physical science.

matter corresponding to the heaps of scoriæ and streams of lava which the volcano pours out on the surface. To one who urges such an objection it may be said that the quantity of solid as well as gaseous matter transferred by springs from the interior of the earth to its surface is far more considerable than is commonly imagined. The thermal waters of Bath are far from being conspicuous among European hot springs for the quantity of mineral matter contained in them in proportion to the water, which acts as a solvent; yet Professor Ramsay has calculated that if the sulphates of lime and of soda, and the chlorides of sodium and magnesium, and the other mineral ingredients which they contain, were solidified, they would form in one year a square column nine feet in diameter, and no less than 140 feet in height. All this matter is now quietly conveyed by a stream of limpid water in an invisible form to the Avon, and by the Avon to the sea; but if, instead of being thus removed, it were deposited around the orifice of eruption, like the siliceous layers which encrust the circular basin of an Icelandic geyser, we should soon see a considerable cone built up, with a crater in the middle; and if the action of the spring were intermittent, so that ten or twenty years should elapse between the periods when solid matter was emitted, or (say) an interval of three centuries, as in the case of Vesuvius between 1306 and 1631, the discharge would be on so grand a scale as to afford no mean object of comparison with the intermittent outpourings of a volcano.

Dr. Daubeny, after devoting a month to the analysis of the Bath waters in 1833, ascertained that the daily evolution of nitrogen gas amounted to no less than 250 cubic feet in volume. This gas, he remarks, is not only characteristic of hot springs, but is largely disengaged from volcanic craters during eruptions. In both cases he suggests that the nitrogen may be derived from atmospheric air, which is always dissolved in rain water, and which, when this water penetrates the earth's crust, must be carried down to great depths, so as to reach the heated interior. When there, it may be subjected to deoxidating processes, so that the nitrogen, being left in a free state, may be driven upwards by the expansive force of heat and steam, or by hydrostatic pressure. This theory has been very generally adopted as best accounting for the constant disengagement of large bodies of nitrogen, even where the rocks through which the spring rises are crystalline and unfossiliferous. It will, however, of course be admitted, as Professor Bischoff has pointed out, that in some places organic matter has supplied a large part of the nitrogen evolved.

Carbonic acid gas is another of the volatilised substances discharged by the Bath waters. Dr. Gustav Bischoff, in the new edition of his valuable work on chemical and physical geology, when speaking of the exhalations of this gas, remarks that they are of universal occurrence, and that they originate at great depths, becoming more abundant the deeper we penetrate. He also observes that when the silicates which enter so largely into the composition of the oldest rocks are percolated by this gas they must be continually decomposed, and the carbonates formed by the new combinations thence arising must often augment the volume of the altered rocks. This increase of bulk, he says, must sometimes give rise to a mechanical force of expansion capable of uplifting the incumbent crust of the earth; and the same force may act laterally so as to compress, dislocate, and tilt the strata on each side of a mass in which the new chemical changes are developed. The calculations made by this eminent German chemist of the exact amount of distension which the origin of new mineral products may cause, by adding to the volume of the rocks, deserve the attention of geologists, as affording them aid in explaining those reiterated oscillations of level, those risings and sinkings of land, which have occurred on so grand a scale at successive periods of the past. There are probably many distinct

causes of such upward, downward, and lateral movements, and any new suggestion on this head is most welcome; but I believe the expansion and contraction of solid rocks, when they are alternately heated and cooled, and the fusion and subsequent consolidation of mineral masses, will continue to rank, as heretofore, as the most influential causes of such movements.

The temperature of the Bath waters varies in the different springs from 117° to 120° F. This, as before stated, is exceptionally high, when we duly allow for the great distance of Bath from the nearest region of active or recently extinct volcanoes and of violent earthquakes. The hot springs of Aix-la-Chapelle have a much higher temperature, viz., 135° F., but they are situated within forty miles of those cones and lava streams of the Eifel, which, though they may have spent their force ages before the earliest records of history, belong, nevertheless, to the most modern geological period. Bath is about 400 miles distant from the same part of Germany, and 440 from Auvergne—another volcanic region, the latest eruptions of which were geologically coëval with those of the Eifel. When these two regions in France and Germany were the theatres of frequent convulsions, we may well suppose that England was often more rudely shaken than now; and such shocks as that of October last, the sound and rocking motion of which caused so great a sensation as it traversed the southern part of the island, and seems to have been particularly violent in Herefordshire, may be only a languid reminder to us of a force of which the energy has been gradually dying out.

If we adopt the theory already alluded to, that the nitrogen is derived from the deoxidation of atmospheric air carried down by rain-water, we may imagine the supply of this water to be furnished by some mountainous region, possibly a distant one, and that it descends through rents or porous rocks till it encounters some mass of heated matter by which it is converted into steam, and then driven upwards through a fissure. In its downward passage the water may derive its sulphate of lime, chloride of calcium, and other substances from the decomposition of the gypseous, saline, calcareous, and other constituents of the rocks which it permeates. The greater part of the ingredients are common to sea-water, and might suggest the theory of a marine origin; but the analysis of the Bath springs by Merck and Galloway shows that the relative proportion of the solid matter is far from agreeing with that of the sea, the chloride of magnesium being absolutely in excess, that is, 14 grains of it per gallon for 12 of common salt; whereas in sea-water there are 27 grains of salt, or chloride of sodium, to 4 of the chloride of magnesium. That some mineral springs, however, may derive an inexhaustible supply, through rents and porous rocks, from the leaky bed of the ocean, is by no means an unreasonable theory, especially if we believe that the contiguity of nearly all the active volcanoes to the sea is connected with the access of salt water to the subterranean foci of volcanic heat.

Professor Roscoe, of Manchester, has been lately engaged in making a careful analysis of the Bath waters, and has discovered in them three metals which they were not previously known to contain—namely, copper, strontium, and lithium; but he has searched in vain for cæsium and rubidium, those new metals, the existence of which has been revealed to us in the course of the last few years by what is called spectrum analysis.

Professor Bunsen, of Heidelberg, led the way, in 1860, in the application of this new test to the hot waters of Baden-Baden and of Dürkheim in the Palatinate. He observed in the spectrum some coloured lines of which he could not interpret the meaning, and was determined not to rest till he had found out what they meant. This was no easy task, for it was necessary to evaporate fifty tons of water to obtain 200 grains of what proved to be two new metals. Taken together, their proportion to the

water was only as one to three millions. He named the first *cæsium*, from the bluish-grey lines which it presented in the spectrum; and the second *rubidium*, from its two red lines. Since these successful experiments were made, *thallium*, so called from its green line, was discovered in 1861 by Mr. Crookes; and a fourth metal, named *indium*, from its indigo-coloured band, was detected by Professor Richter, of Freiberg, in Saxony, in a zinc ore of the Hartz. It is impossible not to suspect that the wonderful efficacy of some mineral springs, both cold and thermal, in curing diseases, which no artificially prepared waters have as yet been able to rival, may be connected with the presence of one or more of these elementary bodies previously unknown; and some of the newly-found ingredients, when procured in larger quantities, may furnish medical science with means of combating diseases which have hitherto baffled all human skill.

While I was pursuing my inquiries respecting the Bath waters, I learned casually that a hot spring had been discovered at a great depth in a copper-mine near Redruth, in Cornwall, having about as high a temperature as that of the Bath waters, and of which, strange to say, no account has yet been published. It seems that, in the year 1839, a level was driven from an old shaft so as to intersect a rich copper-mine at the depth of 1350 feet from the surface. This lode or metalliferous fissure occurred in what was formerly called the United Mines, and which has since been named the Clifford Amalgamated Mines. Through the contents of the lode a powerful spring of hot water was observed to rise, which has continued to flow with undiminished strength ever since. At my request, Mr. Horton Davey, of Redruth, had the kindness to send up to London many gallons of this water, which have been analysed by Professor William Allen Miller, F.R.S., who finds that the quantity of solid matter is so great as to exceed by more than four times the proportion of that yielded by the Bath waters. Its composition is also in many respects very different; for it contains but little sulphate of lime, and is almost free from the salts of magnesium. It is rich in the chlorides of calcium and sodium, and it contains one of the new metals—*cæsium*, never before detected in any mineral spring in England; but its peculiar characteristic is the extraordinary abundance of *lithium*, of which a mere trace had been found by Professor Roscoe in the Bath waters, whereas in this Cornish hot spring this metal constitutes no less than a twenty-sixth part of the whole of the solid contents, which, as before stated, are so voluminous. When Professor Miller exposed some of these contents to the test of spectrum analysis he gave me an opportunity of seeing the beautiful bright crimson line which the *lithium* produces in the spectrum.

Lithium was first made known in 1817 by Arfvedsen, who extracted it from *petalite*; and it was believed to be extremely rare, until Bunsen and Kirchhoff, in 1860, by means of spectrum analysis, showed that it was a most widely diffused substance, existing in minute quantities in almost all mineral waters and in the sea, as well as in milk, human blood, and the ashes of some plants. It has already been used in medicine, and we may therefore hope that, now that it is obtainable in large quantities, and at a much cheaper rate than before the Wheal Clifford hot spring was analysed, it may become of high value. According to a rough estimate which has been sent to me by Mr. Davey, the Wheal Clifford spring yields no less than 250 gallons per minute, which is almost equal to the discharge of the King's Bath or chief spring of this city. As to the gases emitted, they are the same as those of the Bath water—namely, carbonic acid, oxygen, and nitrogen.

Mr. Warrington Smyth, who had already visited the Wheal Clifford lode, in 1855, re-examined it in July last, chiefly with the view of replying to several queries which I had put to him; and, in spite of the stifling heat, ascer-

tained the geological structure of the lode and the exact temperature of the water. This last he found to be 122° Fahr. at the depth of 1350 feet; but he scarcely doubts that the thermometer would stand two or three degrees higher at a distance of 200 feet to the eastward, where the water is known to gush up more freely. The Wheal Clifford lode is a fissure varying in width from six to twelve feet, one wall consisting of *elvan* or porphyritic granite, and the other of *killas* or clay-slate. Along the line of the rent, which runs east and west, there has been a slight throw or shift of the rocks. The vein-stuff is chiefly formed of cellular pyrites of copper and iron, the porous nature of which allows the hot water to percolate freely through it. It seems, however, that in the continuation upwards of the same fissure little or no metalliferous ore was deposited, but, in its place, quartz and other impermeable substances, which obstructed the course of the hot spring, so as to prevent its flowing out on the surface of the country. It has been always a favourite theory of the miners that the high temperature of this Cornish spring is due to the oxidation of the sulphurets of copper and iron, which are decomposed when air is admitted. That such oxidation must have some slight effect is undeniable; but that it materially influences the temperature of so large a body of water is out of the question. Its effect must be almost insensible, for Professor Miller has scarcely been able to detect any sulphuric acid in the water, and a minute trace only of iron and copper in solution.

When we compare the temperature of the Bath springs, which issue at a level of less than 100 feet above the sea, with the Wheal Clifford spring found at a depth of 1350 feet from the surface, we must of course make allowance for the increase of heat always experienced when we descend into the interior of the earth. The difference would amount to about 20° Fahr., if we adopt the estimate deduced by Mr. Hopkins from an accurate series of observations made in the Monkwearmouth shaft, near Durham, and in the Dukinfield shaft, near Manchester, each of them 2000 feet in depth. In these shafts the temperature was found to rise at the rate of only 1° Fahr. for every increase of depth of from 65 to 70 feet. But if the Wheal Clifford spring, instead of being arrested in its upward course, had continued to rise freely through porous and loose materials so as to reach the surface, it would probably not have lost anything approaching to 20° Fahr., since the renewed heat derived from below would have warmed the walls and contents of the lode, so as to raise their temperature above that which would naturally belong to the rocks at corresponding levels on each side of the lode. The almost entire absence of magnesium raises an obvious objection to the hypothesis of this spring deriving its waters from the sea; or if such a source be suggested for the salt and other marine products, we should be under the necessity of supposing the magnesium to be left behind in combination with some of the elements of the decomposed and altered rocks through which the thermal waters may have passed.

Hot springs are, for the most part, charged with alkaline and other highly soluble substances, and, as a rule, are barren of the precious metals, gold, silver, and copper, as well as of tin, platinum, lead, and many others, a slight trace of copper in the Bath waters being exceptional. Nevertheless, there is a strong presumption that there exists some relationship between the action of thermal waters and the filling of rents with metallic ores. The component elements of these ores may, in the first instance, rise from great depths in a state of sublimation or of solution in intensely heated water, and may then be precipitated on the walls of a fissure as soon as the ascending vapours or fluids begin to part with some of their heat. Almost everything, save the alkaline metals, silica, and certain gases, may thus be left behind long before the spring reaches the earth's surface. If this theory be adopted, it

will follow that the metalliferous portion of a fissure, originally thousands of feet or fathoms deep, will never be exposed in regions accessible to the miner until it has been upheaved by a long series of convulsions, and until the higher parts of the same rent, together with its contents and the rocks which it had traversed, have been removed by aqueous denudation. Ages before such changes are accomplished, thermal and mineral springs will have ceased to act; so that the want of identity between the mineral ingredients of hot springs and the contents of metalliferous veins, instead of militating against their intimate relationship, is in favour of both being the complementary results of one and the same natural operation.

(To be continued.)

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2018. Edouard Andries, Schaerbeck, near Brussels, Belgium, "Improvements in means or apparatus for purifying every kind of water, and for rendering it drinkable, and for rendering sea water fresh and drinkable."

2026. Robert Thomson Monteith, St. Malo, France, "Improvements in preserving eggs."—Petitions recorded August 13, 1864.

2043. Peter Armand Lecomte de Fontainmoreau, Rue de la Fidélité, "Certain improvements in the process of preserving animal and vegetable alimentary substances."—A communication from François Xavier Escofet, Paris, France.—Petition recorded August 17, 1864.

2060. Henry Parkes, Birmingham, Warwickshire, "Improvements in the manufacture of colours for dyeing, printing, and other uses."

2063. Julius Thomsen, Copenhagen, Denmark, "Improvements in batteries for generating electricity, and in apparatus for converting the quantity thereof into intensity."—Petition recorded August 19, 1864.

2072. Francis Taylor, Romsey, Hampshire, "Improvements in apparatus for receiving, drying, and deodorising human excrement."—Petition recorded August 22, 1864.

2095. Richard Beard, jun., Clapham, and Walter Downing, Battersea, "Improvements in the manufacture of artificial leather, and in colouring, dyeing, or finishing the same, which latter improvements are also applicable to the colouring or dyeing of the ordinary leather cloth."—Petition recorded August 24, 1864.

2100. Richard Archibald Brooman, Fleet Street, London, "Improved apparatus for lighting and for firing charges in mines and other blasting operations."—A communication from Adolphe Dumas, Privas, France.—Petition recorded August 25, 1864.

2106. Henry Hathaway, Old Kent-road, and William Todd, Manor-street, Old Kent-road, "The application of a new material for the manufacture of paper, cardboard, millboard, papier mâché, and other similar substances."—Petition recorded August 26, 1864.

2126. John Sones, West Bromwich, Staffordshire, "Improvements in coating iron with steel."—Petition recorded August 30, 1864.

Notices to Proceed.

1031. Bounet Frederic Brunel, Brussels, Belgium, "Improvements in treating vegetable fibres, in converting them into pulp, in bleaching the same, and in apparatus employed therein."—Petition recorded April 23, 1864.

1058. Bounet Frederic Brunel, Brussels, Belgium, "Improvements in treating titanite iron sands, and in apparatus employed therein."—Petition recorded April 27, 1864.

1082. John McCall, Houndsditch, London, and Bevan George Sloper, Walthamstow, Essex, "Improvements in

preparing and preserving food."—Petition recorded April 29, 1864.

1181. James Alfred Wanklyn, Finsbury Circus, "The manufacture of purple dye stuffs from manna-sugar."—Petition recorded May 10, 1864.

1686. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the smelting or reducing of lead ores, and in the refining and softening of lead."—A communication from Alexander Hill Everett, New York, U.S.A.

CORRESPONDENCE.

Copper Photography.

To the Editor of the CHEMICAL NEWS.

SIR,—In the last number of the *British Journal of Photography* there is an extract from the CHEMICAL NEWS, giving a short account of a recent observation of M. Renault on the action of light on sub-chloride of copper. I beg to refer your readers to the *Photographic News* of October 7, 1859, page 59, and to the *Mechanic's Magazine* of September 23, 1859, page 199, wherein it will be found that I made the discovery five years ago. I am the more particular of this on two accounts—first, because I consider the discovery a very valuable one, and secondly, because it was original, and one does not make original discoveries so frequently and so easily that one can afford to lose the merit attached thereto. I am, &c.

COLLIN SMART.

Sunderland.

MISCELLANEOUS.

A Monster Gun in America.—Dr. Draper, of New York, writes to the *Journal of Science* (in an article on the "Progress of Science in America") :—A 22-inch gun has been recently successfully cast at Pittsburg on Rodman's principle. In order to make this monster piece of ordnance, which will throw a solid shot of 1000 pounds, 104 tons of metal were melted, though the gun will only weigh, when finished, 56 tons. The essential feature of this system of casting is to cool the iron mass from the interior by means of a stream of water, which is sent to the bottom of the bore in a properly protected pipe, while the exterior is kept hot by a fire round it. In this instance air was substituted for the water after a certain length of time, as the water was found to lower the temperature of the metal too quickly. The running of the iron occupied only 21½ minutes, and the gun was ready for the lathe in a fortnight. These hollow-cast guns are also very durable, the 25-inch at Fortress Monroe having been already fired 505 times.

ANSWERS TO CORRESPONDENTS.

* * All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

* * In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

S. S.—Received with thanks. The translation of Mr. Graham's letter shall appear next week.

Received.—P. C.; W. B.: Reader; Salicine; Dr. Adriani. Answers will appear next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Revision of the Mineral Phosphates, by A. H. CHURCH,
M.A., Professor of Chemistry, Royal Agricultural
College, Cirencester.*

No. I.—DELVAUXITE.

IPURPOSE commencing a series of notes upon the hydrous mineral phosphates by some account of experiments with delvauxite. I have indicated the older atomic weights by italics—for those of Gerhardt the ordinary type is used:—

In Dana's "Mineralogy," (fourth edition, 1855, p. 427) the formula $2Fe_2O_3 \cdot PO_5 + 24HO$ is assigned to delvauxite. This agrees well enough with the experimental percentages of ferric oxide and phosphoric anhydride obtained by MM. Delvaux and Dumont, but it requires 48.3 per cent. of water, while the analytical results varied between 41.13 and 49.76 per cent. of water; no mention is made of calcium as an essential constituent of the mineral—

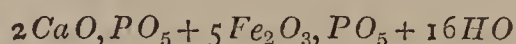
Fe_2O_3	P_2O_5	H_2O	
34.20	16.04	49.76	= 100. Dumont.
40.44	18.20	41.13	= 99.77 Delvaux.

From the latter analysis M. Delvaux deduces the formula— $2Fe_2O_3 \cdot PO_5 + 18HO$. But other expressions have also been proposed.

Delvauxite was analysed by C. V. Hauer in 1854*. The two specimens he examined, though from different localities, gave identical results. One specimen, from the same locality whence the mineral analysed by MM. Delvaux and Dumont was obtained, lost 12.2 per cent of water at 100°, and by ignition suffered a further loss of 13.84 per cent.—in all 26.04 per cent. Dried over chloride of calcium it still retained 17.02 per cent. of water. Deducting 2.08 per cent. of silica, C. von Hauer obtained the following percentages by operating on the mineral dried over chloride of calcium:—

Fe_2O_3	CaO	P_2O_5	H_2O	
52.03	7.94	20.93	19.08	= 99.98

Hence he deduces the formula—



From these conflicting results it is difficult to draw any satisfactory conclusions as to the real formula of the mineral. If chemists had invariably analysed natural phosphates in the same manner as the preparations of the laboratory, the discrepancies in the above results could scarcely have occurred. Many other hydrous mineral species are in an exactly similar predicament—the hygrometric condition at the time of analysis has not been determined. In the case of delvauxite I have just completed a series of experiments with especial reference to this question.

The finely-powdered substance was first exposed in vacuo over sulphuric acid till it ceased to lose weight—

Substance taken	31.055 grains
After four hours' drying	27.47 „
After eight hours' drying	24.74 „
After ten hours' drying	24.74 „

The loss of water, when the substance had ceased to alter in weight, was thus 6.315 grains = 20.33 per cent. The mineral thus far dried, when heated to 100° suffered a further loss, which, when the weight had become constant, amounted to 1.84 grains, or 5.93 per cent. In delvauxite, then, the water driven off by heating the mineral to 100°, amounts to 26.26 per cent.

* *J. pr. Chemie*, lxxiii., 15.

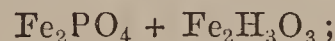
The next experiments were made in order to determine the total amount of water in the mineral. On ignition of the powdered delvauxite, it loses the whole of its water, a trace of carbonic acid gas escaping also; the colour changes, approaching very closely in tint a pigment known as "Mars Violet." The loss on ignition, which may be taken as water only, is considerable, but gives a different result from that obtained in earlier analyses.

1. Substance taken	20.7 grains.
After ignition it weighed	13.0 „
H_2O lost	7.7 „ or 37.198 p.c H_2O .
2. Substance taken	16.1 „
After ignition it weighed	10.1 „
H_2O lost	6. „ or 37.27 p.c. H_2O .

The sample of delvauxite, then, submitted to analysis contained originally 37.234 per cent. of water; of this 20.33 per cent. was lost by simple exposure to the ordinary temperature in vacuo in presence of oil of vitriol. The ratio of phosphoric anhydride to ferric oxide having been already determined with exactness, there remained to be learnt the formula which expresses most accurately the constitutional water of delvauxite after the hygroscopic and accidental water has been removed. Accepting the formula $2Fe_2PO_4 + Fe_2O_3$ for ignited delvauxite, we are led to the following conclusions:—

Pure delvauxite free from hygroscopic moisture has the formula $Fe_2PO_4 + aq. + Fe_2H_3O_3$; which demands 16.31 per cent. H_2O . Experiment gave 16.904 per cent. H_2O .

Delvauxite dried at 100° has the formula—



which demands 10.46 per cent. H_2O . Experiment gave 10.974 per cent. H_2O .

A word or two in conclusion as to the ferric oxide and phosphoric anhydride of delvauxite. Let us revert to the analysis by MM. Dumont and Delvaux, above given, excluding, however, all the water:—

Fe_2O_3	P_2O_5	
68.15	31.85	{ Re-calculated percentages in M. Dumont's
68.99	30.78	{ and in M. Delvaux's analysis.
69.26	30.74	{ Theoretical percentage corresponding to
		{ the formula— $2Fe_2PO_4 + Fe_2O_3$.

A closer accordance between experiment and theory could scarcely be expected; further analyses, though unnecessary, have, however, amply confirmed the above results, which, it will be seen, refer to the anhydrous ignited mineral.

My specimen of delvauxite (from Liège) contains a mere trace of calcium. It leaves after treatment with hydrochloric acid and ignition a residue of silicic acid amounting to 1.67 per cent. If due allowance were made for this, the percentages of water obtained in the analysis would approach still closer to those required by theory.

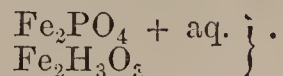
Delvauxite dissolves in cold hydrochloric acid. The solution evaporated to complete dryness leaves a yellowish brown mass, from which water extracts the ferric chloride, the white ferric phosphate remaining insoluble.

My results may be thus given:—

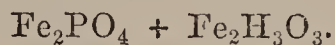
1. Delvauxite contains a large and varying amount of hygroscopic water, so that the formulæ of Dana, and of Odling ("Chemistry," p. 309), represent a substance more or less wet.

2. Delvauxite dried in vacuo over sulphuric acid retains a constant amount of water—is a combination of

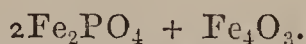
ferric phosphate with ferric hydrate. The H_2O belongs most probably to the former salt; thus:—



3. Delvauxite dried at 100° has the formula



4. Ignited delvauxite has the formula



Researches on the Respiration of Flowers,
by M. AUG. CAHOURS.

WHILE the green portions of plants under the influence of light effect the decomposition of carbonic acid, of which they assimilate the carbon, rejecting the oxygen into the atmosphere, the coloured parts, on the contrary, consume the oxygen to produce carbonic acid. Thus, by one of nature's most admirable harmonies, the atmosphere does not, after ages, become sensibly modified.

But if experiment has long since proved that flowers left in atmospheric air develop carbonic acid at the expense of the oxygen it contains, it is, nevertheless, interesting to determine the modifications presented by this phenomenon under varying circumstances.

Now, do all flowers of equal weight, or of equal surface, consume, under identical circumstances, the same quantity of oxygen, and produce the same proportion of carbonic acid? Do scented flowers behave in the same way as those which are scentless? Does the same flower act more energetically on an atmosphere determined under the influence of a more or less vivid light than in perfect darkness? Is the consumption of oxygen proportionate to the temperature of the medium in which the flower respire? Does a plant consume the same quantity of oxygen at each period of its development? Finally, what do the various parts of the plant—the calyx, corolla, pistil, stamens—respectively play? Such are the questions I propose to resolve.

If we experiment on various flowers of equal weight, arrived at the same state of development, it is easy to ascertain, by operating under perfectly identical conditions, that the respective consumption of oxygen in a given time is far from being the same. As to the more or less powerful odour exhaled by the plant, it seems to play but a trifling part in the production of this phenomenon; in fact, a scentless, or nearly scentless, flower consumes, in a given time, more oxygen than a strongly scented one. Results obtained at the beginning of these researches led me at first to suppose that scented flowers absorbed atmospheric oxygen more rapidly; but later and multiplied experiments on various flowers have shown me that this view could not be established as a general conclusion.

On the other hand, I am convinced that, other things being equal, though the proportion of carbonic acid formed is generally rather greater when the flower is exposed to the light than when it is in perfect darkness, the difference is far from being so great as is supposed. This difference becomes much more manifest when the normal air is replaced by pure oxygen.

When the phenomenon takes place in ordinary air, it is not unusual to find that the results are the same, whether obtained in darkness or in a bright light. This result is very different to those obtained with most organic substances, which, enclosed in equal weights in tubes containing equal volumes of atmospheric air, consume much more oxygen in light than in darkness. The differences observable under these circumstances may

probably be accounted for, in the one case, by the bodies undergoing change being possessed of more or less energetic vitality, and in the other being entirely inert.

In operating on the same plant either in complete darkness or in the light, it is found that as the temperature is raised the proportion of carbonic acid produced in a given time is very appreciably augmented. This result is observable in the most various flowers. When the outer temperature varies from $+15$ to $+25^\circ$, the transformation of oxygen into carbonic acid is rapid; but with temperatures between $+5$ and $+10^\circ$ it is, on the contrary, slow.

The plant does not consume the same quantity of oxygen at different periods of its development, nor produce the same proportion of carbonic acid. Such is the result of a large number of comparative experiments. The differences are, nevertheless, not very considerable. By gathering from the same plant exactly equal weights of buds and full-blown flowers, and placing them respectively in equal volumes of normal air under identical conditions of light and temperature, the consumption of oxygen is almost always slightly greater with the buds than with the full-blown flowers,—a result which is not surprising when we consider that the vital force is greater in the first than in the second instance; still, the difference is never very striking.

Now, all plants being composed of several distinct parts, it may be asked, "What part is taken by each portion in the production of the phenomenon?" To ascertain this, it is necessary to anatomise the flower—to isolate its various parts, to study the part each plays—by putting them respectively in contact with known volumes of normal air—taking their respective weights into consideration—and comparing the results given by the various parts, with the general results derived from the entire plant, the experiment being, moreover, effected under perfectly identical circumstances.

By operating thus on flowers with sufficiently developed pistil and stamens, the weight of which is not a fraction too small for that of the entire flower and the corolla, such as the oriental poppy, the field coquelicot, the coquelicot with large bracts, the lily, the water lily, &c., I found that on comparing the proportion of carbonic acid furnished by the corolla with that given, under the same conditions, by the pistil and stamens, there was a great difference in favour of the latter—a result which might, indeed, have been expected.

Finally, independently of the carbonic acid formed by the combustion of the elements of the flower at the expense of atmospheric oxygen, this gas itself disengages a certain proportion, as may be ascertained by leaving the flowers in an apparatus containing inert gases, such as hydrogen or nitrogen.

In conclusion, I summarise thus:—

1. That all flowers left in a limited atmosphere of normal air consume oxygen and produce carbonic acid in proportions varying as the flower is scentless or not.
2. That the circumstances under which the phenomenon takes place being identical, the proportion of carbonic acid increases as the temperature is raised.
3. That generally with flowers from the same plant and of equal weight the quantity of carbonic acid produced is rather greater when the apparatus in which the experiment is performed is exposed to the light than when it is in darkness; that the proportion is, nevertheless, sometimes the same under either condition.
4. That when the normal air is replaced by pure oxygen the differences become much more marked.
5. That buds produce rather more carbonic acid than

fully-developed flowers, which is explicable by the greater vitality of the buds.

6. That flowers left in inert gas disengage small quantities of carbonic acid.

7. Finally, the pistil and stamens, which possess the greatest vitality of any part of the flower, consume the greatest quantity of oxygen and produce the largest proportion of carbonic acid.—*Comptes Rendus*, lviii., 1206. 64.

EXAMINING BOARDS.

(Continued from page 140.)

SCOTLAND.

THE Scottish Schools open on November 1.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. Lyon Playfair, C.B., F.R.S.

ROYAL COLLEGES OF PHYSICIANS AND SURGEONS, EDINBURGH.

The following Courses of Lectures in connection with these Colleges are delivered:—

Chemistry (School of Arts, Adam Square), 10 a.m., Dr. Stevenson Macadam; Practical Chemistry and Analytical Chemistry, 9 a.m. till 5 p.m., Dr. Stevenson Macadam (at Surgeons' Hall); Chemistry (4, High School Yards), 11 a.m., Dr. A. C. Brown; Practical Chemistry and Analytical Chemistry, 9 a.m. till 5 p.m., Dr. A. C. Brown (4, High School Yards).

Practical Chemistry, 3*l.* 3*s.*; Analytical Chemistry, 2*l.* a month, 5*l.* for three months, or 10*l.* for the Session of six months.

Practical and Analytical Chemistry, Dr. Stevenson Macadam (at Surgeons' Hall); Practical and Analytical Chemistry, Dr. A. C. Brown (4, High School Yards).

UNIVERSITY OF GLASGOW.

Professor of Chemistry.—Thomas Anderson, M.D., F.R.S.E., F.C.S., &c.

Assistants.—Edmund J. Mills, B.Sc., F.C.S., tutor; Magnus M. Tait, F.C.S.; William A. Dixon, F.C.S.; Walter Stewart.

The Courses of Chemical Instruction given by Dr. Anderson are intended to afford to the Student the means of acquiring a thorough knowledge of the Science of Chemistry, and its applications to Medicine and the different branches of the useful arts.

In addition to the Lectures, the class is divided into small sections, which meet separately, and receive tutorial instruction from Mr. Mills.

At certain periods during the Course, written exercises are prescribed, some to be done at home and others in the lecture-room, and without the aid of books or notes.

The Course of Practical Instruction in the Laboratory is arranged in such a manner as to lead the Student through a complete series of Analytical operations.

The fundamental instructions are the same for every pupil, whatever may be the ultimate object of his studies; but after he has acquired a competent knowledge of the general methods of analysis, and a sufficient amount of practical skill, the course for each student diverges into the particular department of the science, or its practical application to Medicine, Agriculture, or the Manufacturing Arts, which he may desire to prosecute.

Students can enter the Laboratory at any time throughout the year.

The Laboratory Fee is 4*l.* 4*s.* for three months; for the Course of Lectures, 3*l.* 3*s.*

ANDERSON'S UNIVERSITY, GLASGOW.

Professor of Chemistry.—Dr. Penny.

The Winter Course of Scientific Lectures on Chemistry will be commenced on Tuesday, November 1, at 10 a.m.

Instruction in Practical Chemistry and Analysis in the Laboratory, daily from 11 till 4.

The Private Laboratory for Commercial Analyses and Assays is open daily throughout the year.

Evening Course of Popular Lectures on Inorganic Chemistry, with special reference to the Industrial Arts, on Fridays, commencing November 4, at 8.30.

Evening Course of Practical Chemistry, on Thursdays, at 7.

GLASGOW MECHANICS' INSTITUTION.

Lecturer on Chemistry.—Dr. Wallace, F.R.S.E., F.C.S.

Assistants.—William Younger and George Gatherall.

The Laboratory is open daily, Saturdays excepted, for instruction in Practical and Analytical Chemistry as applied to the Arts, Manufactures, Mining, and Agriculture. Students may join at any time throughout the year. Fee for six months, 10*l.* 10*s.*

A Course of Lectures on Chemical Technology will be commenced on Tuesday, October 4, at half-past 8 p.m.

An Evening Practical Class for Students connected with Mining and Metallurgical operations will be commenced on Wednesday, November 2, at half-past 7 p.m.

LABORATORY AND LECTURE ROOM, 108, INGRAM STREET, GLASGOW.

A. T. Machattie, Ph.D., F.C.S.

Daily Lectures on Chemistry.—Six months' Course. Fee 2*l.* 2*s.* Beginning on Tuesday, November 1, at 10 a.m.

Analytical Chemistry.—Daily from 9 a.m. till 5 p.m., beginning November 1.

These Classes qualify for the various Medical and Public Boards.

EVENING CLASSES.—*Course of Twenty-five Lectures on Inorganic Chemistry* in the Lecture-hall of the Glasgow Athenæum, on Tuesday evenings at 8, beginning on November 1. The Laboratory is open on Wednesdays and Thursdays, from 7 till 9 p.m., for instruction in Analytical and Practical Chemistry.

EVENING SCIENCE CLASSES.

CARLTON PLACE SECULAR SCHOOL, GLASGOW.

Teacher.—John Mayer, F.C.S.

Chemistry and Metallurgy, especially with the view of passing the Examinations of the Society of Arts and the Government Department of Science and Art.

Lectures on Tuesday and Thursday, at 8 p.m.

ABERDEEN.

Chemistry.—Professor Brazier.

ST. ANDREWS.

Chemistry.—M. Foster Heddle, M.D.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. J. Apjohn.

The Laboratory is open through the year.

CATHOLIC UNIVERSITY.

Professor of Chemistry.—Dr. W. K. Sullivan.

CARMICHAEL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. Davy.

Practical Chemistry in the summer.

LEDWICH SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. Cameron.
Practical Chemistry in the summer.

ROYAL COLLEGE OF SURGEONS.

Lecturer on Chemistry.—Dr. Barker.
Laboratory open throughout the year.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for practical instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer. The Winter Session in Ireland commences at November.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION.

Address by Sir CHARLES LYELL, Bart., LL.D., D.C.L., F.R.S., &c., President. (Delivered before the Members of the Association at Bath, September 14, 1864.)

(Continued from page 144.)

But there are other characters in the structure of the earth's crust more mysterious in their nature than the phenomena of metalliferous veins, on which the study of hot springs has thrown light—I allude to metamorphism of sedimentary rocks.

Various experiments have led to the conclusion that the minerals which enter most largely into the composition of the metamorphic rocks have not been formed by crystallising from a state of fusion, or in the dry way, but that they have been derived from liquid solutions, or in the wet way—a process requiring a far less intense degree of heat. Thermal springs, charged with carbonic acid and with hydro-fluoric acid (which last is often present in small quantities), are powerful causes of decomposition and chemical reaction in rocks through which they percolate. If, therefore, large bodies of hot water permeate mountain-masses at great depths, they may in the course of ages superinduce in them a crystalline structure; and in some cases strata in a lower position and of older date may be comparatively unaltered, retaining their fossil remains undefaced, while newer rocks are rendered metamorphic. This may happen where the waters, after passing upwards for thousands of feet, meet with some obstruction, as in the case of the Wheal Clifford spring, causing the same to be laterally diverted so as to percolate the surrounding rocks. The efficacy of such hydro-thermal action has been admirably illustrated of late years by the experiments and observations of Sénarmont, Daubrée, Delesse, Scheerer, Sorby, Sterry Hunt, and others.

The changes which Daubrée has shown to have been produced by the alkaline waters of Plombières, in the Vosges, are more especially instructive. These thermal waters have a temperature of 160° F., and were conveyed by the Romans to baths through long conduits or aqueducts. The foundations of some of their works consisted of a bed of concrete made of lime, fragments of brick, and sandstone. Through this and other masonry the hot waters have been percolating for centuries, and have given rise to various zeolites—apophyllite and chabazite among others; also to calcareous spar, arragonite, and fluor spar, together with siliceous minerals, such as opal—all found in the interspaces of the bricks and mortar, or constituting part of their rearranged materials. The quantity of heat brought into action in this instance in the course of 2000 years has, no doubt, been enormous, although the inten-

sity of it developed at any one moment has been always inconsiderable.

The study, of late years, of the constituent parts of granite has in like manner led to the conclusion that their consolidation has taken place at temperatures far below those formerly supposed to be indispensable. Gustav Rose has pointed out that the quartz of granite has the specific gravity of 2.6, which characterises silica when it is precipitated from a liquid solvent, and not that inferior density, namely 2.3, which belongs to it when it cools and solidifies in the dry way from a state of fusion.

But some geologists, when made aware of the intervention on a large scale, of water, in the formation of the component minerals of the granitic and volcanic rocks, appear of late years to have been too much disposed to dispense with intense heat when accounting for the formation of the crystalline and unstratified rocks. As water in a state of solid combination enters largely into the aluminous and some other minerals, and therefore plays no small part in the composition of the earth's crust, it follows that, when rocks are melted, water must be present, independently of the supplies of rain-water and sea-water which find their way into the regions of subterranean heat. But the existence of water under great pressure affords no argument against our attributing an excessively high temperature to the mass with which it is mixed up. Still less does the point to which the melted matter must be cooled down before it consolidates or crystallises into lava or granite afford any test of the degree of heat which the same matter must have acquired when it was melted and made to form lakes and seas in the interior of the earth's crust.

We learn from Bunsen's experiments on the Great Geyser, in Iceland, that at the depth of only seventy-four feet, at the bottom of the tube, a column of water may be in a state of rest, and yet possess a heat of 120° Centigrade, or 248° F. What, then, may not the temperature of such water be at the depth of a few thousand feet? It might soon attain a white heat under pressure; and as to lava, they who have beheld it issue, as I did in 1858, from the south-western flanks of Vesuvius, with a surface white and glowing like that of the sun, and who have felt the scorching heat which it radiates, will form a high conception of the intense temperature of the same lava at the bottom of a vertical column several miles high, and communicating with a great reservoir of fused matter, which, if it were to begin at once to cool down, and were never to receive future accessions of heat, might require a whole geological period before it solidified. Of such slow refrigeration hot springs may be among the most effective instruments, abstracting slowly from the subterranean molten mass that heat which clouds of vapour are seen to carry off in a latent form from a volcanic crater during an eruption, or from a lava-stream during its solidification. It is more than forty years since Mr. Scrope, in his work on volcanoes, insisted on the important part which water plays in an eruption, when intimately mixed up with the component materials of lava, aiding, as he supposed, in giving mobility to the more solid materials of the fluid mass. But when advocating this igneo-aqueous theory, he never dreamt of impugning the Huttonian doctrine as to the intensity of heat which the production of the unstratified rocks, those of the plutonic class especially, implies.

The exact nature of the chemical changes which hydro-thermal action may effect in the earth's interior will long remain obscure to us, because the regions where they take place are inaccessible to man; but the manner in which volcanoes have shifted their position throughout a vast series of geological epochs—becoming extinct in one region and breaking out in another—may, perhaps, explain the increase of heat as we descend towards the interior, without the necessity of our appealing to an original central heat or the igneous fluidity of the earth's nucleus.

We have omitted those portions of the President's Address which do not particularly relate to chemistry or physical science, and now proceed to give the opening address, by Dr. Odling, before the Chemical Section.

SECTION B.—CHEMICAL SCIENCE.

President.—W. Odling, M.B., F.R.S., F.C.S.

Vice-Presidents.—Sir B. C. Brodie, Bart, F.R.S.; C. G. B. Daubeny, M.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; A. W. Williamson, Ph.D., F.R.S.

Secretaries.—Professor Liveing, M.A., F.C.S.; A. Vernon Harcourt, M.A., F.C.S.; Robert Biggs.

Committee.—F. A. Abel, F.R.S.; Dr. Attfield, F.C.S.; A. R. Catton; H. Deane, F.L.S.; B. Edwards, Ph.D.; J. P. Gassiot, F.R.S.; E. A. Hadow, F.C.S.; G. W. Knox, B.Sc.; S. Macadam, F.R.S.E.; H. M. Noad, Ph.D., F.R.S.; B. H. Paul, Ph.D.; Professor Roscoe; H. C. Sorby, F.R.S.; C. Tomlinson; Professor Tennant; Professor Voelcker; R. Warrington, F.R.S.; P. Worsley.

Thursday, September 15, 1864.

The PRESIDENT, on rising to deliver his opening address, was received with applause. He said:—

At the Leeds meeting of the British Association in 1858, Sir John Herschel, the then president of the chemical section, opened its proceedings with an introductory address of singular interest, and thereby established a precedent which, with a single exception, has been uniformly followed by successive occupants of the position which I have now the honour to hold. Following in his footsteps *longo intervallo*, I in my turn now venture upon a few words of introduction to the proper business that we have in hand. In the first place, I may congratulate the section upon the presence among us of so many distinguished chemists, including several of my more immediate predecessors. I need scarcely express the personal gratification I feel at meeting them here, nor say how much their presence relieves me from the feeling of responsibility and self-mistrust with which I undertook the honourable office so kindly entrusted to me by the committee, feeling now that upon every occasion of difficulty I shall have them to apply to for counsel and assistance.

After the great diversity, or rather antagonism, of opinion which has existed for the last dozen years or so, I am almost bound to take a somewhat prominent notice of the substantial agreement which now prevails among English chemists as to the combining proportions of the elementary bodies, and the molecular weights of their most important compounds. The present unanimity of opinion on this fundamental subject among those who have given it their attention is, I conceive, greater than has ever been the case since Dalton published his New System of Chemical Philosophy more than half a century ago. As yet, indeed, the unanimity of practice falls considerably short of the unanimity of belief, but even in this direction great progress is being made, to which the publication of Miller's "Elements of Chemistry," Watt's "Dictionary of Chemistry," and Hofmann's "Jury Report on the Chemical Products in the Great Exhibition," will doubtless give a yet stronger impetus. As was well observed by Dr. Miller at a previous meeting of this Association, "Chemistry is not merely a science, it is also an art which has introduced its nomenclature and its notation into our manufactories, and in some measure even into our daily life." Hence the great difficulty of effecting a speedy change in chemical usages alike so time honoured and intimately ramified. I propose, with your permission, to make a few remarks upon the history of this chemical reformation, more especially in connection with certain points which some of its most distinguished leaders have scarcely, I think, correctly estimated.

From the time when Dalton first introduced the expression "atomic weight," up to the year 1842, when Gerhardt announced his views upon the molecular constitution of

water, there does not seem to have been any marked difference of opinion among chemists as to the combining proportions of the principal elements. That 1 part by weight of hydrogen, united with 36 parts by weight of chlorine to form a single molecule of hydrochloric acid, and with 8 parts by weight of oxygen to form a single molecule of water, was the notion both of Berzelius and Gmelin, who may be taken as representatives of the two chief Continental schools of theoretic chemistry. There was, indeed, no difference of opinion whatever between them as to the combining proportions of the three elements. Using the hydrogen scale of numbers, both chemists represented the combining proportion of hydrogen as 1, that of chlorine as 36, and that of oxygen as 8. Both, moreover, represented the molecular weight of hydrochloric acid as 37, and the molecular weight of water as 9. True it is that Berzelius professedly regarded the single combining proportions of hydrogen and chlorine as consisting each of two physical atoms; but since the two atoms of hydrogen, for instance, which constitute the one combining proportions of hydrogen, were chemically inseparable from one another, they were really tantamount to one atom only of hydrogen, and, as a matter of fact, were always employed by Berzelius as representing the single chemical atom of hydrogen, or its smallest actual combining proportion.

Distinguishing thus, between the physical atom and the combining proportion, Berzelius' recognition of the truth that equal volumes of the elementary gases contain an equal number of atoms was utterly barren. But identifying the physical atom with the combining proportion, Gerhardt's recognition, or rather establishment of the broader truth, that equal volumes of all gases, elementary and compound, contain the same number of atoms, has been in the highest degree prolific. From Gerhardt's division of volatile bodies into a majority whose recognised molecules corresponded respectively with four volumes of vapour, and a minority, whose recognised molecules corresponded respectively with but two volumes; and from his proposal, in conjunction with Laurent, to double the molecular weights of these last, so as to make the molecules of all volatile bodies, simple and compound, correspond each with four volumes of vapour, must, I conceive, be traced the development by himself and others of the matured views on chemical philosophy which now prevail. With every respect for my predecessor in this chair, and for the accomplished author of the "Leçons de Philosophie Chimique," from neither of whom do I ever venture to differ without fear and trembling, I cannot join with them in regarding the initiation of Gerhardt's system as an imperfect return, and its remarkable maturation in these recent days as a more complete return to the notions of Berzelius. It is true that the elementary weights now employed, with the exception of those for some half-dozen metals, are identical with the atomic weights of Berzelius, but so different are they from his combining weights, that fully four-fifths of all known compounds have to be expressed by formulæ entirely different from his; namely, all those bodies, with but a very few exceptions, into which hydrogen, fluorine, chlorine, bromine, iodine, nitrogen, phosphorus, arsenic, boron, and the metals lithium, sodium, potassium, silver, and gold, enter as constituents. Fully admitting that the new system of atomic weights, as it now exists, is the joint product of many minds, fully admitting that it owes its present general acceptance chiefly to the introduction of the water type by Williamson during Gerhardt's lifetime, and the recognition of diatomic metals by Würtz and Cannizzaro after his decease, and fully admitting, moreover, that some of Gerhardt's steps in the development of his unitary system were decidedly, though perhaps excusably, retrograde, I yet look upon him, not I trust with the fond admiration of the pupil, but the calm judgment of the chemist, as being the great founder of

that modern chemical philosophy, in the general spread of which I have already ventured to congratulate the members of the section.

Prior to the time of Gerhardt, the selection of molecular weights for different bodies, elementary and compound, had been almost a matter of hazard. Relying conjointly upon physical and chemical phenomena, he first established definite principles of selection, by pointing out the considerations upon which the determination of atomic weights must logically depend. Relying upon these principles, he established his classification of the non-metallic elements into monohydrides represented by chlorine; dihydrides represented by oxygen; terhydrides represented by nitrogen, &c.; and relying upon the same principles, but with a greatly increased knowledge of phenomena, later chemists have given to his method a development and unity, more especially as regards the metallic elements, which have secured for the new system the impregnable and acknowledged position which it at present occupies. The comparative unanimity which prevailed before the time of Gerhardt was the unanimity of submission to authority, but the greater unanimity which now prevails is the unanimity of conviction, consequent upon an intermediate period of solitary insurrection, general disturbance and ultimate triumph.

Bearing in mind how much the origin of the new system by Gerhardt, and its completion by his colleagues and disciples are due to a correct appreciation of the harmony subsisting between chemical and physical relations, we cannot but give a hearty welcome to any large exposition of mixed chemico-physical phenomena; and whether or not we agree with all his conclusions, there can be but one opinion as to the obligation chemists are under to Professor Kopp, of Giessen, for the great addition he has recently made to our knowledge, and means of obtaining a further knowledge of what has hitherto been but a very limited subject—namely, specific heat.

The agreement of chemists as to the elemental atomic weights is tantamount to an agreement among them as to the relative quantities of the different kinds of matter which shall be represented by the different elemental symbols, and this brings me to the subject of chemical notation. At one time many chemists, even of considerable eminence, believed and taught that Gerhardt's reformation had reference mainly to notation, and not to the association and interpretation of phenomena, and it became rather a fashion among them to declaim against the puerilities of notational questions. That the idea is of far greater importance than the mode of expressing it is an obvious truism; but, nevertheless, the mode of expression has an importance of its own as facilitating the spread of the idea, and more especially its development and procreation. It has been well asked, in what position would the science of arithmetic have been but for the substitution of Arabic for Roman numerals, the notation in which value is expressed by the change in position for that in which it is expressed mainly by the repetition of a few simple signs.

It is unfortunately too true that chemical notation is at present in anything but a satisfactory state. The much-used sign of addition is, I conceive, about the last one would deliberately select to represent the fine idea of chemical combination, which seems allied rather, I should say, to an interpenetration than to a coarse apposition of atoms. The placing of symbols in contiguity, or simply introducing a point between them, as indicative of a sort of multiplication or involution of the one atom into the other, is, I think, far preferable; but here, as pointed out by Sir John Herschel, we violate the ordinary algebraic understanding, which assigns very different numerical value to the expressions xy and $x + y$ respectively. I know, indeed, that one among us has been engaged for some years past in conceiving and working out a new and strictly philosophical system of chemical notation by means of actual formulæ, instead of mere symbols, and I am sure

that I only express the general wish of the section when I ask Sir Benjamin Brodie not to postpone the publication of his views for a longer time than is absolutely necessary for their sufficient elaboration.

In any case, however, the symbolic notation at present employed, with more or less modification of detail, must continue to have its peculiar uses as an instrument of interpretation, and hence the importance of our endeavouring to render it more precise in meaning and consistent in its application. Many of its incongruities belong to the very lowest order of convention; such, for example, as the custom of distinguishing between the representation of so-called mineral and organic compounds, one particular sequence of symbols being habitually employed in representing the compounds of carbon, and an entirely different sequence of symbols in representing the more or less analogous compounds of all other elements. Now that organic and mineral chemistry are properly regarded as forming one continuous whole, a conclusion to which Kolbe's researches on sulphuretted organic bodies have largely contributed, it is high time that such relics of the ancient superstition, that organic and mineral chemistry were essentially different from one another, should be done away with.

Although during the past year the direct advance of that crucial organic chemistry, the synthesis of natural organic bodies, has not been striking, yet, on the other hand, its indirect advance has, I submit, been very considerable. Several of the artificially produced organic compounds at first thought to be identical with those of natural origin, have proved to be, as is well known, not identical, but only isomeric therewith. Hence, *reculer pour mieux sauter*, chemists have been stepping back a little to examine more intimately the construction both of natural organic bodies and of their artificial isomers. The synthetic power having been attained of putting the bricks together in almost any desired way, it is yet necessary, in order to construct some particular biological product, to first learn the way in which its constituent bricks have been naturally put together. We accordingly find the study of isomerism, or what comes to the same thing, the study of the intimate construction of the bodies, is assuming an importance never before accorded to it. Isomerism is, in fact, the chemical problem of the day, and concurrently with its rapidly advancing solution, through the varied endeavours of many workers, will be the advance in rational organic synthesis.

It is curious to note the oscillations of opinion in reference to this subject. Twenty years ago the molecular constitution of bodies was perceived by a special instinct simultaneously with, or even prior to, the establishment of their molecular weights. Then came an interval of scepticism, when the intimate constitution of bodies was maintained to be not only unknown, but unknowable. Now, we have a period of temperate reaction not recognising the desired knowledge as unattainable, but only as difficult of attainment. And in this, as in many other instances, we find evidence of the healthier state of mind in which now more perhaps than ever the first principles of chemical philosophy are explored. Speculation, indeed, is not less rife, and scarcely less esteemed than formerly, but is now seldom or never mistaken for ascertained truth. Scepticism, indeed, still prevails, not, however, the barren scepticism of contentment, but the fertile scepticism which aspires to greater and greater certainty of knowledge.

Chemical science is advancing, I believe, not only more rapidly, but upon a surer basis than heretofore; and while, with every advance, the prospect widens before our eyes, so that we become almost alarmed at contemplating what those who come after us will have to learn, we console ourselves with the determination that their labour of unlearning shall be as little as possible, far less, we hope, than what we in our time have had to experience.

At the conclusion of the President's address the following papers were read* :—

Dr. Gladstone—*Report of the Committee on the Application of Gun-cotton to Warlike Purposes.*

Dr. Miller—*On the Analysis of a Hot Spring containing Lithium and Cæsium in Wheal Clifford.*

Dr. Daubeny—*On the Bath Waters.*

Dr. Paul—*Note on Some of the Constituents of the Oil known as Crude Paraffin Oil.*

Friday, September 16, 1864.

On Friday the following papers were read in Section B :

Rev. G. F. Browne—*On the Prismatic Formation of Ice.*

A. R. Catton—*On the Direct Conversion of Acetic Acid into Butyric and Caproic Acids.*

Dr. W. Bird Herapath—*On a New Method of Discovering the Hydrogen Compounds of Arsenic, Sulphur, Antimony, and Phosphorus when in Company as a Mixed Gas.*

Dr. T. Anderson—*On some Bituminous Substances.*

Stewart Clark—*Description of an Apparatus for Estimating the Organic Impurities in Atmospheric Air and in Water.*

Dr. Stevenson Macadam—*On the Pollution of Rivers by the Sewage of Towns.*

Dr. Henry Bird—*On the Utilisation of Sewage.*

A deputation from the Chemical Section also attended this morning in Section F, (Economic Science and Statistics), when Mr. James Heywood read a *Report of a Committee of the British Association on Uniformity of Weights and Measures.*

On Friday evening Professor Roscoe delivered a lecture in the Theatre on *The Chemical Action of Light.*

Saturday, September 17, 1864.

There was no meeting in Section B to-day, as a number of members of the Chemical Section of the British Association paid a visit to Bristol for the purpose of inspecting some of the principal manufactories. Amongst them were Dr. Odling, Chairman of the Section, Sir Benjamin Brodie, Professor Williamson, Professor Miller, Professor Roscoe, and other distinguished chemists, as well English as foreign. After going over Messrs. Finzel and Co.'s colossal sugar refinery at Counterslip, Messrs. Panter's lead works, Messrs. Powell's bottle works, &c., the visitors repaired to the works of Christopher Thomas and Brothers, the St. Philip's-plain soap works, where they were entertained at a handsome champagne luncheon. Having done justice to the good things provided for them, the visitors went over the works, being accompanied by the partners and by Mr. W. L. Carpenter, the intelligent chemist of the establishment.

Monday, September 19, 1864.

The following papers were read in Section B :—

A. R. Catton—*On the Molecular Constitution of Carbon Compounds.*

Maxwell Lyte—*On an Apparatus for the Preservation or Disengagement of Sulphuretted Hydrogen, Carbonic Acid, or Other Gases.*

W. Poole King—*On the Premature Decay of the Frescoes in the Houses of Parliament; its Cause and Remedy.*

Professor Tennant—*On the Colouring of Agates.*

Alphonse Gages—*On the Artificial Production of Anhydrite.*

Dr. Phipson—*On the Black Stones which fell from the Atmosphere at Birmingham.*

Frederick Field—*On a Specimen of Tin Ore, hitherto undescribed.*

Dr. Williamson—*On Isomorphism.*

P. Spence—*On Copper Smelting.*

Professor Wanklyn—*On the Rational Formula of Rosaniline.*

* We have refrained from giving our own reports of these papers, as we hope to receive corrected copies of all the more important ones from the authors. They will appear under their proper headings in subsequent numbers of the CHEMICAL NEWS.

Professor Wanklyn—*On the Composition of Certain Organic Dyes.*

Tuesday, September 20, 1864.

The following papers were read before the Chemical Section :—

Professor Wanklyn—*On a Curious Example of Etherification.*

A. Vernon Harcourt—*On the Rate of Chemical Change.*

Professor Roscoe—*On a Chemical Photometer for Meteorological Observation.*

Professor Roscoe—*Contributions towards the Foundation of a Quantitative Photography.*

T. Fairley—*On the Action of Hydrogen upon Organic Polycyanides.*

Professor Rogers—*On Gas Tests.*

Dr. Paul—*On Useful Applications of Slag from Iron Smelting.*

Wednesday, September 21, 1864.

The following papers were read before the Chemical Section :—

Dr. G. Kemp—*Memorandum on Ozone.*

Wentworth Scott—*On Some Probable New Sources of Thallium.*

Professor W. B. Rogers—*To Exhibit the Inventions of Mr. Cornelius, of Philadelphia, for Lighting Gas Burners by Electricity.*

A. C. Kirk—*On the Production of Cold by the Expansion of Air.*

S. Mossman—*Some Observations on the Constitution of the Atmosphere.*

W. Gee—*Account of the Mode adopted at the Bradford Union for the Utilisation of Sewage.*

Dr. Paul—*On the Disposal of Town Refuse.*

Alfred Noble—*On Reaumur's Porcelain.*

S. Highley—*Description of a Cheap Form of Automatic Regulator for the Electric Light.*

BRITISH PHARMACEUTICAL CONFERENCE.

President, H. DEANE, F.L.S.

Bath, September 16.

WE commence our notices of the proceedings of the Conference with an abstract of the Report of the Committee on "Accidental Poisoning," read by Mr. J. Raymond King at the third meeting.

After referring to the great interest which the subject of accidental poisoning had excited in the minds of members, the desirability of a thorough investigation of the question, with the object of preventing the recurrence of accidents, and the difficulties which beset the question, the report went on to state the course of proceeding adopted by the Committee in order to make the discussion of the subject interesting and practical. The Committee thought it advisable that their deductions and remarks should be based upon the results of statistical inquiry. They carefully examined the cases of accidental poisoning, as reported in the *Pharmaceutical Journal*, from July, 1862, to June, 1864, inclusive. These are twenty-five in number, and may be thus summarised :—Ten cases in which the mistake was committed by the administrator; two by a surgeon, one by a wholesale house, one by a grocer's wife, and eleven by retail chemists or their assistants. The cases were elaborately detailed in the report; and after a careful examination of the merits of each, and an intimation that the Committee had corresponded with many gentlemen likely to form an opinion on the subject, the Committee came to the following conclusions :—

1. That there are seventeen out of the twenty-five cases in which there is every reason to believe that a thoroughly effective poison-bottle would have prevented the accident.
2. That there are at least three cases in which, had the poison sold been folded in black paper, and labelled properly, the accident would not have occurred.

3. That 80 per cent. of the usual cases of accidental poisoning may be prevented by the use of proper precautions.

4. That only one of the twenty-five cases was the direct result of ignorance.

The practical suggestions and recommendations made by the Committee may be thus summarised:—

1. That to every one engaged in the practice of pharmacy, the facilities which exist for acquiring a theoretical as well as a practical knowledge of their business, renders it incumbent upon them to do all in their power to make themselves thoroughly acquainted with their profession, in order to future safety and usefulness.

2. That a separate and suitable part of their shops or premises be set apart for dispensing prescriptions wherever this has not already been done.

3. That in the dispensing department there be a repository toxicorum, or poison cupboard, with lock and key, in which should be kept all the concentrated and virulent poisons; or a small bottle of each sufficient for present use, the bottles being filled from store bottles, which should be kept in another and larger store cupboard or room, as required.

4. That the labels upon all shop and store bottles be in future so placed that the whole of the label can be seen at a glance, on the plan introduced by Messrs. Ford and Shapland, of London, instead of writing round the bottles, as at present arranged.

5. That wherever practicable, every prescription be checked by a second person before it is sent out.

6. That liniments, lotions, and all poisonous liquids be dispensed in bottles registered by Mr. Merrikin, of Bath, and called "Merrikin's Caution Bottles," as being in the opinion of the Committee superior to any other bottle hitherto used for the purpose, and that the labels be printed in red ink.

7. That the more concentrated and potent poisons, such as strychnine, morphia, prussic acid, &c., should not be sold in an unmixed state, without a medical order, under any circumstances whatever.

8. That no poison be sold in a dangerous quantity by any assistant or apprentice without the express sanction of the principal.

9. That every poison, in addition to its name, be distinctly marked "Poison" before it is sent out, excepting medicines dispensed from a prescription where the statement of the dose or use of it may be considered sufficient.

10. That dry poisons, such as oxalic acid, sugar of lead, red and white precipitate, &c., be invariably folded in black paper; and in addition to the name of the article, that a label with the word "Poison," in bold white letters on a black ground be securely attached to each packet.

The report was thoroughly practical, and was well received by the members of the Conference. It concluded by a forcible appeal to all in any way connected with the practice of pharmacy to advance themselves in scientific as well as practical knowledge, to discourage as much as possible the long hours of business to which both employers and employes are subject, thus weakening the power of concentration of mind on business matters, and rendering them irksome and distasteful, the consequence of which might possibly be serious both to themselves and the public. The committee thankfully acknowledged the assistance rendered by correspondents from various parts of the kingdom, and especially to the local secretary of the Conference, Mr. J. C. Pooley, of Bath, for the aid rendered to them in preparing and completing the report.

A long and important discussion then ensued. In the course of it a communication from Mr. Halliday was read, proposing a plan of raising a fund from which to indemnify chemists and druggists who, like Messrs. Clay and Abrahams, in the late Liverpool case, might be compelled, under Lord Campbell's Act, to pay heavy damages to the family of a person who had died from poison through pure

misadventure, and admittedly not from any fault of the chemist and druggist. This proposition was, however, very generally negatived by the meeting. The existence of such a fund would lay them open to inevitable prosecution, whereas now a man would not be proceeded against unless he were known to be possessed of a few spare thousands, which was not the case with very many chemists and druggists. Many other objections were expressed. The general feeling was that the law should be altered, not met.

The following papers were read at other meetings of the Conference, of most of which we shall give reports:—

C. R. Tichborne, F.C.S.—*On the Extraction and Preservation of Aromata.*

Mr. C. Umney—*On Commercial Carbonate of Bismuth.*

Mr. F. Baden Benger—*On the Pharmaceutical Applications of Glycerine.*

J. Attfield, Ph.D., F.C.S.—*On the Application of Dialysis in determining the Crystalline Constituents of Plants.*

Mr. F. C. Clayton—*On Foreign Iodide of Potassium.*

Mr. John Tuck—*On a Test for Methylic Alcohol when Mixed with Ethylic Alcohol; with Remarks on Methylated Spirit.*

Mr. S. B. Proctor—*Report on the Weights and Measures used in Pharmacy.*

Henry Deane, F.L.S., and Henry B. Brady, F.L.S., F.C.S.—*On the Application of Microscopic Analysis to Pharmacy.*

Mr. James Spearing—*On Commercial Podophyllin.*

Mr. W. Walter Stoddart—*On the Purity of the Sulphate of Quinine of Commerce.*

D. Hanbury, F.L.S.—*A Chemist's Holiday—Jottings in France.*

T. B. Groves, F.C.S.—*On the Rancidity of Fats.*

Mr. W. D. Savage—*On the Processes for Preparing some of the Tinctures of the Pharmacopœias.*

Mr. J. T. P. B. Warren—*On the Cultivation of Medicinal Plants at Mitcham.*

Mr. T. Grundy—*On the Preparation of Small Quantities of Concentrated Infusions.*

Mr. J. Adams—*On Potentilla Tormentilla, Linn.*

J. B. Edwards, Ph.D., F.C.S.—*On the Old Calabar Bean.*

Mr. W. E. Heathfield—*On the Morphia Salts of Commerce.*

R. Parkinson, Ph.D.—*On Commercial Phosphoric Acid.*

T. B. Groves, F.C.S.—*On the Assay of the Alkaloids in Medicinal Extracts.*

H. N. Draper, F.C.S.—*On an Improved Wine of Iron.*

F. Sutton, F.C.S.—*On Commercial Wine of Iron, with Suggestions.*

Mr. F. M. Rimmington—*On the Powders of Opium, Ipecacuanha, and Jalap, as met with in Commerce.*

Mr. J. C. Braithwaite—*On the amount of Alkaloid in Commercial Citrate of Iron and Quinine.*

Mr. A. F. Haselden—*Note on Cusparine.*

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, June 10, 1864.

"On a Magnetic Experiment," by JOHN TYNDALL, Esq., F.R.C.S., M.R.I., Professor of Natural Philosophy, Royal Institution.

THERE are two words which are very often employed in scientific writings—matter and force. The definition of each involves the conception of the other. We know nothing of force save through its operations upon matter, and we know nothing of matter save through the manifestations of its force. The characteristics of any force must be sought in the material changes which it is competent

to produce. Some years ago I felt a great interest in the subject of magnetism, and in those years I devised an apparatus to enable me to investigate certain mechanical effects which accompany the act of magnetisation. I wished to apply this apparatus to diamagnetic bodies as well as paramagnetic ones—to bodies such as bismuth, as well as to bodies such as iron. I intend this evening to show you the action of this instrument, and to give, if I can, some explanation of the experiments of others which have been confirmed by my own.

Let us pass quickly in review the excitation of this wonderful power of magnetism. Here is a strong horseshoe magnet set upright, and here is a bent bar of steel, whose arms are the same distance apart as those of the horseshoe magnet. I draw the bent steel bar over the ends, or the poles, as they are called, of the magnet. It suddenly obtains the power of attracting this iron keeper and holding it fast. I reverse the stroke of the steel bar: its virtue has now disappeared; it is no longer competent to attract the keeper. I continue the stroke of the steel bar in the last direction, and now it is again competent to attract the iron: thus I can at will magnetise and demagnetise this bent piece of steel.

Here is a fine permanent magnet constructed by Logeman, of Haarlem, and competent to carry a great weight. Here, for example, is a dish of iron nails, which it is able to empty. At the other side of the table you observe another mass of metal bent like the Logeman magnet, but not, like it, naked. This mass, moreover, is not steel, but iron, and it is surrounded by coils of copper wire. It is intended to illustrate the excitement of magnetism by electricity. At the present moment this huge bent bar is so inert as to be incapable of carrying a single grain of iron. I now send an electric current through the coils that surround it, and its power far transcends that of the steel magnet on the other side. It can carry fifty times the weight. It holds a 56 lb. weight attached to each of its poles, and it empties this large tray of iron nails when they are brought sufficiently near it. I interrupt the current: the power vanishes, and the nails fall.

Now, the magnetised iron cannot be in all respects the same as the unmagnetised iron. Some change must take place among the molecules of the iron bar at the moment of magnetisation. And one curious action which accompanies the act of magnetisation I will now try to make sensible to you. Other men laboured, and we are here entering into their labours: the effect I wish to make manifest was discovered by Mr. Joule,* and was subsequently examined by MM. De la Rive, Wertheim, Marian, Matteucci, and Wartmann. It is this:—At the moment when the current passes through the coil surrounding the electro-magnet, a clink is heard emanating from the body of the iron, and at the moment the current ceases a clink is also heard. In fact, the acts of magnetisation and demagnetisation so stir the atoms of the magnetised body that they, in their turn, can stir the air and send sonorous impulses to our auditory nerves.

I have said that the sounds occur at the moment of magnetisation, and at the moment when magnetisation ceases; hence, if I can devise a means of making and breaking in quick succession the circuit through which the current flows, I can obtain an equally quick succession of sounds. I do this by means of a contact-breaker which belongs to a Ruhmkorff's induction coil. Here is a monochord, and a thin bar of iron stretches from one of its bridges to the other. This bar is placed in a glass tube, which is surrounded by copper wire. I place the contact breaker in a distant room, so that you cannot hear its noise. The current is now active, and every individual in this large assembly hears something between a dry crackle and a musical sound issuing from the bar in consequence of its successive magnetisation and demagnetisation.

Hitherto we have occupied ourselves with the iron which has been acted upon by the current. Let us now devote a moment's time to the examination of the current itself. Here is a naked copper wire which is quite inert, possessing no power to attract these iron filings. I send a voltaic current through it; it immediately grapples with the filings, and holds them round it in a thick envelope. I interrupt the current, and the filings fall. Here is a compact coil of copper wire which is overspun with cotton to prevent contact between the convolutions. At present the coil is inert; but now I send a current through it: a power of attraction is instantly developed, and you see that it is competent to empty this plate of iron nails.

Thus we have magnetic action exhibited by a body which does not contain a particle of the so-called magnetic metals. The copper wire is made magnetic by the electric current. Indeed, by means of a copper wire through which a current flows, we may obtain all the effects of magnetism. I have here a long coil, so suspended as to be capable of free motion in a horizontal direction: it can move all round in a circle like an ordinary magnetic needle. At its ends I have placed two spirals of platinum wire which the current will raise to brilliant incandescence. They are glowing now, and the suspended coil behaves in all respects like a magnetic needle. Its two ends show opposite polarities; it can be attracted and repelled by a magnet, or by a current flowing through another coil; and it is so sensitive that the action of the earth itself is capable of setting it north and south.

There is an irresistible tendency to unity in the human mind; and, in accordance with our mental constitution, we desire to reduce phenomena which are so much alike to a common cause. Hence the conception of the celebrated Ampère that a magnet is simply an assemblage of electric currents. Round the atoms of a magnet Ampère supposed minute currents to circulate incessantly in parallel planes; round the atoms of common iron he also supposed them to circulate, but in all directions—thus neutralising each other. The act of magnetisation he supposed to consist in the rendering of the molecular currents parallel to a common plane, as they are supposed to be in a permanent magnet.

This is the celebrated theory of molecular currents propounded by Ampère. You observe it consists in the application of conceptions obtained from sensible masses of matter to insensible or atomic masses. Let us follow out this conception to what would appear its legitimate consequences. I have said that we obtain both attractions and repulsions from electric currents: all these effects are deduced from one law, which is, that electric currents flowing in the same direction attract each other, while, when they flow in opposite directions they repel each other. Let me illustrate this law rapidly. Here are two flat coils suspended facing each other, and about eight inches apart. I send a current through both, causing it to flow through them in the same direction; the coils instantly clash and cling together in virtue of their mutual attraction. I now reverse the current through one of them, and they fly a yard asunder, in virtue of their mutual repulsion. And now one of them twists its suspending wire so as to turn its opposite face to the other coil; the currents are now again in the same direction, and the coils clash and cling as in the first instance. Imagine, then, our molecular currents flowing round the atoms of this iron bar in planes perpendicular to the length of the bar. From the law just enunciated we should infer the mutual attraction of those currents; and from this attraction we should be disposed to infer the shortening of the bar at the moment of magnetisation. Here, for example, is a coil of copper wire suspended vertically; the end of the coil dips into this little basin of mercury. From a small volcanic battery behind I send a current through the coil; and because it passes in the same direction through all its convolutions, they attract each other. The coil is thereby shortened;

* The sound, I find, was first noticed by Mr. Page.—J. T., June 16.

its end quits the mercury with a spark; the current ceases; the wire falls by its own gravity; the current again passes, and the wire shortens as before. Thus you have this quick succession of brilliant* sparks produced by the shortening of the wire and the interruption of the current as it quits the mercury.

Is it a fact, then, that an iron bar is shortened by the act of magnetisation? It is not. And here, as before, we enter into the labours of other men.

Mr. Joule was the first to prove that the bar is lengthened. Mr. Joule rendered this lengthening visible by means of a system of levers and a microscope, through which a single observer saw the action. The experiment has never, I believe, been made before a public audience; but the instrument referred to† at the commencement of this lecture will, I think, enable me to render this effect of magnetisation visible to everybody present.

Before you is an upright iron bar, two feet long, firmly screwed into a solid block of wood. Sliding on two upright brass pillars is a portion of the instrument which you see above the iron bar. The essential parts of this section of the apparatus are, first, a vertical rod of brass, which moves freely and accurately in a long brass collar. The lower end of the brass rod rests upon the upper flat surface of the iron bar. To the top of the brass rod is attached a point of steel; and this point now presses against a plate of agate, near a pivot which forms the fulcrum of a lever. The distant end of the lever is connected, by a very fine wire, with an axis on which is fixed a small circular mirror. If the steel point be pushed up against the agate plate, the end of the lever is raised; the axis is thereby caused to turn, and the mirror rotates. I now cast a beam from an electric lamp upon this mirror; it is reflected in a luminous sheaf, fifteen or sixteen feet long, and it strikes our screen, there forming a circular patch of brilliant light. This beam is to be our index; it will move as the mirror moves, only with twice its angular velocity; and the motion of the patch of light will inform us of the lengthening and shortening of the iron bar.

I employ one battery simply to ignite the lamp. I have here a second battery to magnetise the iron bar. At present no current is passing. I make the circuit, and the bright image on the screen is suddenly displaced. It sinks a foot. I break the circuit: the bar instantly shrinks to its normal length, and the image returns to its first position. I make the experiment several times in succession: the result is always the same. Always when I magnetise, the image instantly descends, which declares the lengthening of the bar; always when I interrupt the current, the image immediately rises. A little warm water projected against the bar causes the image to descend gradually. This, I believe, is the first time that this action of magnetism has been seen by a public audience.

I have employed the same apparatus in the examination of bismuth bars; and, though considerable power has been applied, I have hitherto failed to produce any sensible effect. It was at least conceivable that complementary effects might be here exhibited, and a new antithesis thus established between magnetism and diamagnetism.

No explanation of this action has, to my knowledge, been offered; and I would now beg to propose one which seems to be sufficient. I place this large flat magnet upon the table; over it I put a paper screen; and on the screen I shake iron filings. You know the beautiful lines in which those filings arrange themselves—lines which have become classical from the use made of them in this Institution; for they have been guiding-threads for Faraday's intelligence while exploring the most profound and intricate phenomena of magnetism. These lines indicate the

direction in which a small magnetic needle sets itself when placed on any of them. The needle will always be a tangent to the magnetic curve. A little rod of iron, freely suspended, behaves exactly like the needle, and sets its longest dimension in the direction of the magnetic curve. In fact, the particles of iron filings themselves are virtually so many little rods of iron, which, when they are released from the friction of the screen by tapping, set their longest dimensions along the lines of force. Now, in this bar magnet the lines of force run along the magnet itself, and, were its particles capable of free motion, they also would set their longest dimensions parallel to the lines of force—that is to say, parallel to the length of the magnet. This, then, is the explanation which I would offer of the lengthening of the bar. The bar is composed of irregular crystalline granules; and, when magnetised, these granules tend to set their longest dimensions parallel to the axis of the bar. They succeed, partially, and produce a microscopic lengthening of the bar, which, suitably magnified, has been rendered visible to you.‡

Perhaps you do not see the magnetic curves from your present position, but I will enable you to see them. I have here an electric lamp turned on its back, and from it a vertical cylinder of light now issues. Over the aperture of the lamp I place two small bar magnets, enclosed between two plates of glass. The vertical beam is received upon a looking-glass which reflects it on to the screen. In the path of this reflected beam I place a lens, and thus obtain upon the screen a magnified image of the two small bar magnets. And now I sprinkle this fine iron sand on the plate of glass, and you see how it arranges itself under the operation of the magnets. A most beautiful display of the magnetic curves is now before you. And you observe when I tap the glass how the particles attach themselves by their ends, and how the curves close in upon each other. They try to attach themselves thus and close thus up in the solid iron bar: the consequence is that the longitudinal expansion is exactly counterbalanced by the transverse contraction, so that the volume of the bar remains unchanged.

But can we not bring a body with moveable particles within an electro-magnetic coil? We can; and I will now, in conclusion, show you an experiment devised by Mr. Grove, which bears directly upon this question, but the sight of which, I believe, has hitherto been confined to Mr. Grove himself. At all events, I am not aware of its ever having been made before a large audience. I have here a cylinder with glass ends, and it contains a muddy liquid. This muddiness is produced by the magnetic oxide of iron which is suspended mechanically in water. Round the glass cylinder I have coiled five or six layers of covered copper wire; and here is a battery from which a current can be sent through the coil. First of all, I place the glass cylinder in the path of the beam from our electric lamp, and, by means of a lens, cast a magnified image of the end of the cylinder on the screen. That image at present possesses but feeble illumination. The light is almost extinguished by the suspended particles of magnetic oxide. But, if what I have stated regarding the lines of force through the bar of magnetised iron be correct, the particles of the oxide will suddenly set their longest dimensions parallel to the axis of the cylinder, and also in part set themselves end to end when the current is sent round them. More light will be thus enabled to pass; and now you observe the effect. The moment I establish the circuit the disc upon the screen becomes luminous: I interrupt the current, and gloom supervenes; I re-establish it, and we have a luminous disc once more.

The apparatus, as I have stated, was really invented to examine whether any mechanical effect of this kind could

* Rendered brilliant by the introduction of a coil of wire and a core of soft iron into the circuit.

† Very skilfully constructed by Mr. Becker.

‡ My assistant, Mr. Barrett, has just drawn my attention to a paper by M. De la Rive in which this explanation is given. To him, therefore, belongs the entire credit of it.—J. T., June 16.

be detected in diamagnetic bodies; but hitherto without result. And this leads me to remark on the large ratio which the failures of an original inquirer bear to his successes. The public see the success—the failure is known to the inquirer alone. The encouragement of his fellow-men, it is true, often cheers the investigator and strengthens his heart; but his main trials occur when there is no one near to cheer him, and when, if he works aright, he must work for duty and not for reputation. And this is the spirit in which work has been executed in this Institution, by a man who has, throughout his life, turned a deaf ear to such allurements as this age places within the reach of scientific renown; and it behoves every friend of this Institution to join in the wish that that man's spirit may continue to live within its walls, and that those who come after him may not shrink from his self-denial while endeavouring to merit a portion of his fame.

ACADEMY OF SCIENCES.

September 12.

THE first paper read was of great interest, though not chemical. It was by the astronomer, M. Faye, "*On Errors in Observation which have a Physiological Origin*," and showed that two senses in operation together never act simultaneously. The eye acting alone will measure the most minute distances; the ear can distinctly appreciate the hundredth of a second; and the touch will recognise vibrations at the rate of 500 to a second. But no two astronomers watching the passage of a star and counting the beats of a pendulum will agree as to the precise moment of time at which the star passes the meridian. Means, however, have been found to obviate these errors, inseparable from human observations and increased by indigestions, fatigue, and numerous other causes, so far as the sun is concerned, by photography and the electric telegraph; and the author hopes that it will be found possible to employ the same agents in observations on the stars.

M. de Luca contributed a paper entitled "*Chemical Researches on the Spontaneous Decomposition of Pyroxiline*." The author points out that the decomposition is greatly accelerated by the action of direct sunlight or artificial heat. Among the products of the slow decomposition he found glucose, gummy matters, oxalic acid, a small amount of formic acid, and what he believes to be a new acid, of which he intends to give a further account. The glucose amounted to 14 per cent. of the original weight of gun-cotton. The products of spontaneous decomposition in *vacuo* seem to be the same as in air.

M. Bechamp presented a note giving a further account of his soluble ferment *zymase*, which we noticed in a recent number. He finds an analogous substance in flowers, which he therefore names *anthozymase*, and also in the juice of fruits, *morozymase*. These ferments have the power of converting cane sugar—which, according to M. Bechamp, is no sugar—into real sugar, glucose. They do not act on glucosides, at least they do not split up salicine, nor do they transform starch. They are therefore specific ferments. The two latter are precipitated from the pressed juices of fruits and flowers by alcohol.

In a note on the "*Solubility of Salts*," M. Alluard describes a stove for keeping solutions at a constant temperature, which does not seem to possess any particular advantage.

CORRESPONDENCE.

Continental Science.

PARIS, September 21.

M. DUPORTEUIL, one of the engineers of the *Chemin de fer de l'Ouest*, has lately been applying the hydraulic press to welding large pieces of wrought iron. The steady com-

pression exercised by the hydraulic press is stated to have great advantages over the intermittent blows of the steam hammer.

Your contemporary *Galignani* is so famous for flying scientific *canards*, that I give you the following somewhat reluctantly:—M. Corbelli has discovered a means of producing aluminium in large quantities directly from clay, without the use of sodium. The clay is first cleansed from stones, bits of wood, and other accidental impurities, and then dried. One hundred grammes are then washed in nitric, sulphuric, or hydrochloric acid, to remove the iron with which it is generally contaminated. The purified clay is then dried and heated in a crucible to 450° or 500° C. Two hundred grammes of prussiate of potash and 150 grammes of common salt are then thrown in, and the whole is then heated to whiteness. In the cold crucible a button of aluminium will be found.

The German scientific journals mention a singular case of poisoning by anilic compounds. A young man, whose daily duty it was to pack aniline powder colours, and who, consequently, took large quantities of the dust into his lungs, although he took the precaution of using a pocket handkerchief as a respirator, found himself attacked with a severe cough, accompanied by anomalous symptoms, such as great weakness, and constant fainting fits, dilatation of the pupils, pains in the head, and convulsions of the muscles of the face and of the extremities. The symptoms, however, passed away in time, and the young man recovered with no further bad effects than the total loss of his hair.

The twenty-fifth anniversary of the foundation of the Observatory of Pulkowa was celebrated on the 19th ult. The Central Hall of the Observatory was crowded with astronomers from all parts, anxious to do honour to the veteran philosopher, M. W. Struve, the founder of this celebrated Observatory. The visitors were received by the venerable *savant* and his talented son, M. Otto Struve, acting director of the Observatory, surrounded by the whole of the scientific staff. Addresses were given by both father and son, in which they expressed their hope that the cordial co-operation which at present exists between astronomers of all nations would be continued. M. Otto Struve referred especially to the great good effected by the zeal shown by the members of the Royal Astronomical Society of London, and spoke of the advantages that had resulted from the intimate alliance existing between the two great centres of astronomical science, Greenwich and Pulkowa. Mr. Warren de la Rue, President of the Royal Astronomical Society, represented Great Britain; Professor Henner, of Gotha; M. Clausen, of Dorpat; Dr. Bruhns, of Leipzig; Dr. Förster, of Berlin; Dr. Schönfeld, of Mannheim, and several other astronomers of eminence were present, to the number of one hundred. Singularly enough, France was unrepresented.

In the *Moniteur* a few days since there appeared a report to the Emperor emanating from the pen of M. Duruy, the indefatigable Minister of Public Instruction, giving the names of those who, besides M. Rhumkorff (who, as I have before informed you, gained the 50,000 francs prize) have done the state some service in the application of voltaic electricity to useful purposes, and who are adjudged honourable mention. They are M. Lenoir, for his gas engine; M. Caselli, for his telegraphic apparatus; M. Gaiffe, for his method of engraving by electricity; M. Bonelli, for his electric loom; Mr. Hughes, for his electro-printer; M. Froment, for his electro-motion engines; MM. Foucault and Serrin, for their electric lamp, and one or two more of less note. M. Froment is recommended for the officers' cross of the Legion of Honour. The same prize will be adjudged for the same purpose in 1868, when I hope to see a few more Englishmen in the list.

A go-ahead Yankee firm having offered a prize of 1000

dollars in the *New York Tribune* to the inventor of an artificial substance having the properties of ivory, to replace that substance for billiard-balls, a M. Dupré has produced a material from paper pulp, sulphate of baryta, and gelatine, which, according to two of our crack billiard players here, is quite equal to ivory in every respect for this particular purpose.

From artificial ivory to artificial butter there is only one step. Here is the receipt for it:—Half a kilogramme of mutton fat, melted in about 270 grammes of fresh milk. When fully dissolved, and while still warm, filter through muslin and add 625 grammes of *poppy oil*, stirring the while. Put the whole once more over the fire and add 60 grammes of *crust of bread* (!), 15 grammes of *tarragon* (!!), and—Heaven help us—*two onions cut fine* (!!!), after which strain again. The inventor states that the mixture has enormous advantages over the real article, and that pastry made with it is particularly light, and of a most appetising flavour. In these days of advanced science one really must be careful with whom one breakfasts, for fear of being made a *corpus vile*. I refrain from giving you the name either of the inventor of this notable compound or that of the scientific journal in which the receipt appears.

Dr. Barth, in the *Réforme Agricole*, recommends benzol as a perfect cure for any parasitical affection, such as itch, *pediculi* in the human subject, ticks in cattle, &c. It has long been a remedy in England for curing dogs of fleas.

I fear that French scientific writers never look at the current scientific literature of other countries, or an esteemed writer in *Cosmos* would not have only just found that Dr. *Danglish* had invented a method of making bread without yeast.

Discovery of Dialysis.

To the Editor of the CHEMICAL NEWS.

SIR,—The following is the translation of a letter from Mr. Graham, which appeared in the last weekly number of the *Mondes*, in reply to a communication on the subject of M. Dubrunfaut's alleged anticipation of the discovery of dialysis, which was published in the number of that journal for August 11. We have reason to believe that Mr. Graham's letter was duly forwarded on August 15, although not published till three weeks afterwards:—

"As a constant reader of the *Mondes*, I could not fail to observe the account given in a recent number of that journal of a new process invented by M. Dubrunfaut, and patented on June 22, 1863, to extract sugar from molasses by dialysis. I have little doubt that by dialysis through parchment paper M. Dubrunfaut might succeed in separating gum and a portion of the colouring matter from molasses; but the earlier process of the same chemist, patented on April 1, 1854, appears to be different in principle, and intended to effect a separation of crystalline salts, but not gum and colloid colouring matters, from sugar—an effect which, as you justly observe, is not dialysis. For neither animal membrane nor parchment paper has any effect in separating different crystalline substances from one another. All such bodies, when in solution, pass through membrane with the same facility. The separation of salts from sugar which was observed by M. Dubrunfaut could only be very partial, and I may be allowed to say that it is simply the effect of the greater rapidity of diffusion in water possessed by the potash salts than by the crystalline sugar contained in the molasses. In fact, as is directly proved in my memoir of 1854, that the interposed membrane goes for nothing in the phenomenon. A great number of separations by diffusion of artificial and natural mixtures of salts (as, for instance, sea-water) are described in my memoir on the diffusion of liquids, which is printed in the *Annales de Chimie et de Physique* for May, 1850 (t. 29, p. 197)."

It is to be observed of Dubrunfaut's first patent of April 1, 1854, that it does not effect a dialysis, but the

separation (very partial) of crystalloids by diffusion, which had been previously exemplified in great detail in Mr. Graham's original paper on "Liquid Diffusion," published in the *Philosophical Transactions* of 1850, or four years before. Again, the second patent of M. Dubrunfaut, dated June 22, 1863, is manifestly founded on Mr. Graham's paper on dialysis published a year earlier, in 1862, from which the use of parchment paper has been borrowed by the patentee. I am, &c. S. S.

Numerical Relations of Equivalents.

To the Editor of the CHEMICAL NEWS.

SIR,—Mr. Noble, in his eloquent and elaborately studied reply to "Studiosus," has endeavoured to "kill two birds with one stone;" for after disposing of the law of "Studiosus" in a very summary and thoroughly original manner, he proceeds to fall foul of Mr. Newland, stigmatising the relations which the latter has pointed out as "a great deal of nonsense, and in many cases mere rubbish"—terms, to say the least, not over complimentary.

Regarding the "approximations and allowances" which Mr. Noble so strongly condemns, I find that they are largely made use of, not only by the parties whom he takes to task, but also by Dumas, Gregory, Mercer, and others, who have written upon this subject. For instance, in Abel and Bloxam's Handbook (second edition, p. 525) the difference between the equivalents of rhodium and palladium amounting to 1.1, or using Williamson's equivalents to 2.5, is described as "very slight, and probably due to mere errors of analysis."

Surely the authority of Professor Abel upon such a matter will not be questioned—at all events, not in Woolwich Arsenal.

Mr. Noble is of opinion "that it is much easier to find laws for the equivalent numbers than to verify the equivalents experimentally; but really the two things have no more connection than 'chalk and cheese.'" For my own part, if any comparison be advisable, I could mention a hundred chemists who either have verified, or are fully capable of verifying, an ordinary equivalent; but I do not know a single chemist who can thoroughly exhibit all the relations among the atomic weights, still less one who can explain why and wherefore such relations exist.

I am, &c., INQUIRER.

London, September 6.

MISCELLANEOUS.

British Association.—The next meeting of the Association will be held at Birmingham under the presidency of Professor Phillips.

ANSWERS TO CORRESPONDENTS.

* * All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements and Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

In order to give early reports of the proceedings of the British Association and the Pharmaceutical Conference, we are compelled to defer for a time the publication of several interesting papers, and our usual "Notices of Books."

Dr. Adriani's lengthy reply to Dr. Schwarz must be deferred for the present.

W. B.—Not available for aniline, but their presence is not objectionable.

P. C.—Nitrate of potash and charcoal, tipped with the usual phosphorous composition. For the scented fuses, the pastille composition may be used.

Chemical.—Several patents and new processes are noticed in various numbers of the CHEMICAL NEWS, but no details for guiding manufacturers. You will find an account of the ordinary process in Knapp and Richardson's "Technology." No letter received before.

Salicine.—1. We do not remember that it has been done. 2. Ettling's process by heating benzoate of copper is, perhaps, the easiest.

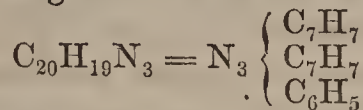
Reader.—Yes, in tolerably strong solutions.

SCIENTIFIC AND ANALYTICAL
CHEMISTRY.

On the Rational Formula of Rosaniline,*
by J. ALFRED WANKLYN.

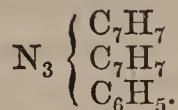
ACCORDING to Hofmann, the empirical formula for anhydrous rosaniline is $C_{20}H_{19}N_3$; the salts being $C_{20}H_{19}N_3XH$ and $C_{20}H_{19}N_3 \cdot 3XH$, whilst the base on being liberated from one of its salts takes the form $C_{20}H_{19}N_3, H_2O$.

It will be apparent that anhydrous rosaniline is just equal to a base consisting of two atoms of toluyll and one of phenyl along with three atoms of nitrogen.



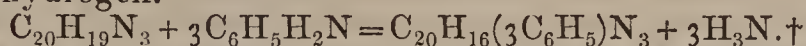
This manner of constructing the formula of rosaniline, which appears to be adopted by some chemists, derives a remarkable confirmation from the circumstance discovered by Hofmann, that it is requisite to employ a mixture of toluidine and aniline in the manufacture of rosaniline, neither toluidine nor aniline alone being capable of yielding the dye.

Notwithstanding this capital fact, it is quite certain that rosaniline is not



In several reactions rosaniline displays three atoms of easily replaceable hydrogen.

Thus in the famous process for producing aniline blue three atoms of phenyl are changed against three atoms of hydrogen.



Hofmann's beautiful research relating to this transformation of aniline red into aniline blue leaves no doubt that three atoms of hydrogen are concerned.

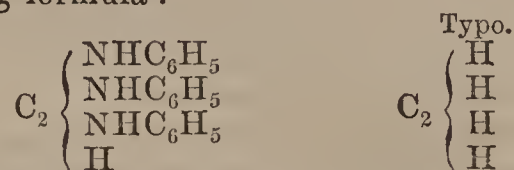
Again the iodides of the alcohol radicals react upon rosaniline, producing ethylated bases. Hofmann has not yet published his research on "Ethyl-roosaniline," but judging from the quantity of iodide of ethyl actually destroyed in the operation, there can be little doubt that substitution goes on to the length of three atoms.

In order to judge whether this action upon the "hydrogen atoms" in rosaniline must be looked upon as a very close representation of the action upon the hydrogen atoms in common ammonia, I have inquired whether Carey Lea's method was applicable to rosaniline.

Carey Lea, as is well known, has shown that nitrate of ethyl occupies a place among the very few ethers capable of forming ethylated ammonias by reaction upon ammonia. I have recently succeeded in obtaining ethylated rosaniline by the action of nitrate of ethyl upon rosaniline.

From all this it results that the rational formula of rosaniline must display three atoms of hydrogen in association with nitrogen.

A consideration of the entire case leads me to propose the following formula:—

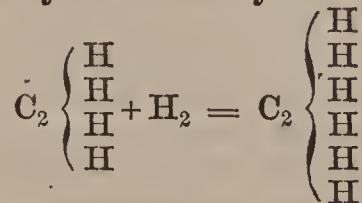


* Read before the British Association Bath Meeting, and communicated by the Author.

† The first suggestion of the kind of change which takes place when aniline red becomes aniline blue was, I believe, due to me. In the winter 1862-63 I explained it by saying that aniline red lost hydrogen and gained phenyl; supporting my view by adducing the facts that the red gave more than its weight of blue while ammonia was evolved.

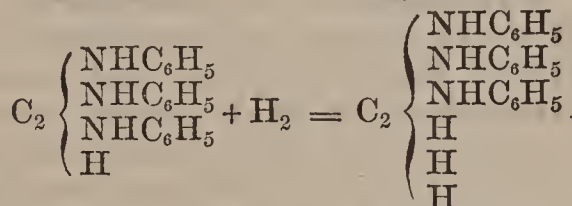
I here write rosaniline on the "ethylene" type, replacing three atoms of typical hydrogen by three atoms of phenylamid.

Just as ethylene tends to take up the representatives of two atoms of hydrogen, and thereby passes into a body of the "hydride of ethyl" type, so rosaniline tends to take up two atoms of hydrogen, thereby becoming a representative of hydride of ethyl.



Rosaniline.

Leucaniline.

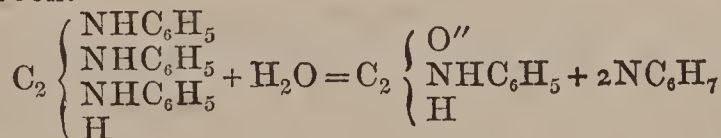


The three atoms of hydrogen in union with the three atoms of nitrogen are, of course, easily replaceable.

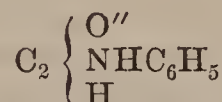
The fourth atom of hydrogen being in direct association with carbon is not easily replaceable.

The power that nitrogen has of being either three or five atomic is, of course, the explanation of the mono-acid and tri-acid salts. There should be likewise bi-acid salts.

Quite in accordance with the formula is the fact that distillation with potash gives much aniline and a residue of carbon.



The group



would, on maltreatment, be very likely to carbonise.

A reaction which may be predicted is this. Careful treatment with alkali may be expected to give aniline and glycollic acid.

Query.—Does not pure aniline, free from toluidine, give rosaniline on treatment with chloride of carbon?

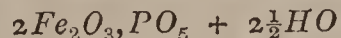
London Institution.

Revision of the Mineral Phosphates, by A. H. CHURCH, M.A. Oxon, Professor of Chemistry, Royal Agricultural College, Cirencester.

(Continued from page 146.)

No. II.—DUFRENITE.

To dufrenite or green iron ore the formula



is assigned by Dana. Professor Odling, in the list of orthophosphates given on page 309 of his "Manual of Chemistry," writes this mineral $Ffe'''PO_4Ffe'''H_3O_3$, but has not, I believed, published, any experimental proofs of this formula. Having submitted a specimen of dufrenite from Bavaria to analysis, I can now confirm Professor Odling's view.

The water in this mineral is in part retained obstinately; if determined by the loss on moderate ignition, the percentage will prove too low. Another cause also will conduce to the same result—dufrenite occurs in radiating fibrous concretions upon an anhydrous matrix, generally hæmatite. Now, it is extremely difficult to prevent any admixture of the anhydrous

mineral with the dufrenite taken for analysis; the dark silky crystals of the latter must be carefully examined by a hand magnifier to ascertain their perfect homogeneity. The following results were obtained with a most carefully selected specimen of dufrenite, which was submitted in a state of fine powder to the drying action of sulphuric acid in vacuo:—

22.78 grains of dufrenite, after two days' drying, as above, weighed 22.75 grains.

The mineral contains, therefore, no hygroscopic water; nor does the air-dried mineral alter in weight when kept in the water-oven.

The total amount of water contained in dufrenite is shown by the following numbers:—

22.75 grains gave 2.4 grains water.

This result corresponds to 10.55 per cent. H_2O . The formula $Fe_2PO_4 + Fe_2H_3O_3$ requires 10.46 per cent. H_2O . It is remarkable that the ferric hydrate presumed to exist in dufrenite (and delvauxite) should not be altered by a heat of $100^\circ C.$, which changes the simple precipitated ferric hydrate $Fe_2H_3O_3$ into $Fe_4O_3 + 2H_2O$ ($=Fe_4H_4O_5$), with the loss from 2 atoms of the hydrate of 1 atom of water. Although air-dried dufrenite has the same composition as delvauxite dried at 100° , yet the chrome-green colour of the former mineral is strikingly different from the red-brown tint of the latter. After ignition the minerals are also identical in composition, but the colours of the ignited residues are not alike—that of delvauxite having a violet or purple shade not seen in the orange-red residue of dufrenite.

Note on the Existence of Lithium, Strontium, and Copper in the Bath Waters, by Professor ROSCOE, F.R.S.*

At the request of Sir Charles Lyell I undertook the examination of the residue obtained by the evaporation of the Bath waters (King's Bath spring) by spectrum analysis. About four ounces of the deposit from the basin in the pump-room was kindly forwarded to me by Dr. Falconer. This was first examined for strontium, barium, lithium, rubidium, and caesium, by first boiling it out with water acidulated with hydrochloric acid; this separated the sulphate of calcium, of which the deposit mainly consists, together with most of the sulphates of strontium and barium which might be present. The residue was fused with carbonate of sodium, and the carbonates examined for barium and strontium, according to the method described by Bunsen. No trace of barium was found, but strontium was present in quantities sufficiently large to enable it to be easily detected. The portion of the deposit soluble in dilute hydrochloric acid was freed from alkaline earths by several precipitations with carbonate and oxalate of ammonia, and in this precipitate strontia was again detected. The magnesium was next separated by ignition of the mixed chlorides with oxide of mercury, and on examining the portions of the residue soluble in water, the red lithium line was plainly visible. The alkalis were precipitated as platinum double salts, but after long washing no other lines than those of potassium could be detected. It appeared, however, possible that the greater portion of the more soluble alkaline salts might not be spontaneously deposited from the water; I therefore requested Dr. Falconer to obtain some residue from the evaporation of the whole water, but on examining, according to

the above method, the salts thus derived from twenty gallons of water, I was still unable to detect the smallest traces of either rubidium or caesium. In the course of both analyses I detected the presence of copper in the deposit by the usual tests. I have to thank Mr. Charles Moore for his kindness in forwarding a number of samples of various deposits from the Bath springs, some of which I have examined, but without discovering any other substance whose presence was previously unknown in the Bath waters.

Researches on Sulphuretted Combinations of Uranium, by M. ADOLPHE REMELE.

(Continued from page 124.)

Sulphuranylates of Potash and Soda.—In treating nitrate of uranium, dissolved in alcohol, by a solution of monosulphide of potassium or hydrosulphate of sulphide of sodium, precipitates of a beautiful orange colour are obtained, which may be washed in alcohol diluted with water. After undergoing washing for a sufficient length of time, they disengage with acids, a little sulphuretted hydrogen, but no free sulphur is separated, perhaps because there are not homogenous products.

When the precipitation is effected with sulphide of sodium in an aqueous solution, the precipitate is after a longer or shorter time transformed into a grey-green matter. This it is impossible to filter, whether water or alcohol is used for the washing. In either case the colour becomes brownish yellow, and part of the matter traverses the pores of the paper.

Brown Sulphuranylate of Baryta.—This is the most alterable of all these bodies I have examined. For its preparation precipitate an alcoholic solution of nitrate of uranium by sulphide of barium dissolved in water, and wash with alcohol at 36° . The dark brown-red precipitate decomposes rapidly in the air, becoming brick red, and this decomposition takes place up to a certain point even when the precipitate is impregnated with a strong proportion of alcohol. Immediately after receiving it on the filter, place it under the receiver of an air pump, but even then a partial transformation is almost unavoidable.

Hydrochloric acid dissolves the brown matter with disengagement of sulphuretted hydrogen. Nevertheless a milkiness remains in the liquid, proceeding from a little free sulphur.

Green Sulphuranylate of Baryta.—By adding a soluble salt of baryta to the black solution of sulphide of uranyle in hydrosulphate of ammonia a dirty green precipitate is formed. To collect this it should be immediately thrown on a filter, and then washed on the filter with water as cold as possible, until the washings cease to colour a solution of acetate of lead, when it should be dried in a vacuum.

The substance obtained treated by hydrochloric acid disengages sulphuretted hydrogen with brisk effervescence; the acid solution is rendered milky by the separation of free sulphur. On heating the green body over a lamp in a tube closed at one end a very curious phenomenon of light is produced. At about 200° all the matter suddenly becomes incandescent.

Two analyses of this product gave me 14.5 per cent. of uranium, 49 per cent. of barium, and 14 per cent. of sulphur. These numbers lead me to conclude, at least approximatively, that there are six equivalents of sulphide of barium for one equivalent of sulphide of uranyle. The formula of the green compound, which also contains water, would then be $= [Ur_2O_2] S.6BaS + aq.$

* Read at the British Association Bath meeting. Communicated by the author.

By washing the green precipitate in water, the temperature of which is very little above the ordinary point, the substance becomes transformed into a dirty yellow mass by abandoning sulphide of barium. It is then no longer possible to wash the green sulphuranylate by decanting, for whilst it remains in contact with a somewhat considerable quantity of water it is slowly transformed, provided access of air is limited, into brown sulphuranylate, and the liquid takes a strong green colour from the sulphide of barium. This remarkable fact proves that the brown-red compound contains less alkaline-earthly sulphide than green sulphide.

Uranium Red.—Sulphide of uranyle, after precipitation from a solution of nitrate of uranium in water, is transformed after twenty-four or forty-eight hours into a beautiful blood red matter, when the liquid in which the change is effected is exposed to the air. Several chemists have already observed this phenomenon; M. Rivot has observed the change of colour is effected more rapidly (in less than six hours) when the hydrosulphate has been used in a previous precipitation.

The red substance, which I propose to call uranium red, is relatively stable; it can be sufficiently well washed with pure water, and afterwards may be dried at about 100° without any apparent decomposition. By drying it contracts considerably, and becomes darker; after being pulverised it shows under the microscope octahedral crystals, or small cubes with the modifications of the octahedral. These crystals, which are of a dark red colour, are disseminated in a light red mass; in thin layers, yellowish portions are, however, visible.

The analysis many times repeated of a product of this kind yields the following numbers—uranium, 71 per cent., sulphur, 4.5 per cent.; ammonia, 1.9 per cent.; water, about 10 per cent. These numbers lead to no rational formula. Ammonia is not indispensable to the existence of the red body, for it may be expelled by potash without affecting the colour.

It is easy to ascertain that uranium red cannot be a definite compound, but, on the contrary, that it is invariably a mixture. In collecting successively, at intervals of eight or twelve hours, the products obtained from one and the same liquid, the red colour becomes brighter and brighter. This is easily explained, as there always remains along with the red matter a certain quantity of sulphide of uranyle, which by washing is transformed more or less completely into hydrated sesquioxide of uranium. Analyses also of different products yield for the various elements results which often differ by several hundredths from one another.

What, then, is the colouring principle in uranium red? By heating it in a closed tube, or a tube open at one end, to 230 or 250° , an ammoniacal salt is sublimated which is hyposulphite of ammonia; the solution of this salt in water, treated at a gentle heat by sulphuric acid, disengages a very notable proportion of sulphurous acid, becoming at the same time milky, by the separation of free sulphur. Hence it would seem that hyposulphurous acid enters into the composition of uranium red; as to the uranium itself, the result of my experiments and analyses is, that it exists, in chief part at least, in the state of protoxide. It would then seem that uranium red is produced by hyposulphurous acid which forms in hydrosulphate of ammonia through the intervention of the air; and the essential matter may be a hyposulphite of protoxide of uranium. I submit this as a simple hypothesis,—it is not impossible we may have to do with a sub-sulphide of uranyle.

Uranium red is insoluble in water; but it generally

remains partially suspended for an almost indefinite time, colouring the liquid light red. It possesses several characteristics of hyposulphites; a solution of nitrate of silver, for instance, blackens it immediately, and after a time the filtered liquid deposits yellow hyposulphite of silver. On the other hand, it evinces several reactions which perfectly distinguish it from ordinary hyposulphites. Thus, hydrochloric, nitric, and sulphuric acids, even when much diluted, dissolve it, disengaging only a little sulphuretted hydrogen, and separating the greater part of the sulphur under the form of yellowish flakes.*

An insufficient quantity of these same acids leaves a darker red residue. The same thing takes place when the substance is treated by a solution of carbonate or sulphite of ammonia, which decompose it equally well. The residue, less easily attackable by these various reagents, appears in the form of small octahedral crystals, which on trituration resume the colour of the original matter; it contains besides free sulphur.

In the present state of knowledge on the subject, the following is all I can say on the nature of uranium red:—

So long as it remains in the state of hydrosulphate of ammonia it is a mixture of a red crystalline body, the composition of which is still doubtful, with sulphide of uranyle†. After washing it becomes a mixture of the same red body with hydrated sesquioxide of uranium and a small quantity of sulphate of uranyle.

In each case there is a little hyposulphite of ammonia, but it has been hitherto found impossible to ascertain whether this salt exists in combination or not.

Direct Preparation of Uranium Red.—By all imaginable means I have endeavoured to produce the colouring matter of uranium red in a pure state, first with hyposulphite of ammonia and soda on almost neutral solutions of sesquioxide and protoxide of uranium, but without producing a substance analogous to the red product; on the contrary, hyposulphites do not even give precipitates with salts of uranium.

A very singular observation at length led me in a more satisfactory direction. By treating nitrate of uranium by a solution of sulphite of ammonia, mixed with hydrosulphate of ammonia, there is formed when the proportions of the two reagents bear a certain proportion to each other, a precipitate variable in colour, which contains in a mixed state a certain quantity of a light red mass. After numerous experiments made in consequence of this phenomenon, I succeeded in preparing uranium red by direct processes. The following is the most successful method:—

As the point of departure I take a beautiful yellow precipitate, obtained by treating nitrate of uranium by a solution of crystallised sulphite of ammonia (which always contains a more or less considerable proportion of free ammonia). This precipitate can be easily washed in water, which, however, partly dissolves it; by drying, which can be effected at 100° , it becomes very hard, and after being pulverised shows, under the microscope, small prismatic crystals. In the tube the matter disengages sulphurous vapours and free ammonia; with energetic acids it gives sulphurous acid; uranium is present in the state of sesquioxide. The results of its analysis are:—Sesquioxide of uranium, 78.66 per cent.; sulphurous acid, 12 per cent.; ammonia, 2.28 per cent.; water, 6.02 per

* Uranium red behaves, in this respect, in much the same way as sulphide of uranyle.

† Protoxide of uranium and sulphur are also obtained by heating uranium red in presence of hydrosulphate; for this it is only necessary to heat it more and for a longer time than unaltered sulphide of uranyle.

cent. From this it would seem to be a mixture of uranate of ammonia and sulphite of oxide of uranyle, with the same composition as the salt studied by Girard. The analysed product contains, setting aside the water, about 66 parts of anhydrous sulphite ($[\text{U}_2\text{O}_2]\text{O}.\text{SO}_2$) to 28 parts of uranate ($2[\text{U}_2\text{O}_2]\text{O}.\text{NH}_4\text{O}$)

By treating the precipitate of sulphite of uranium, in the same liquid in which it is produced, by a prolonged current of sulphuretted hydrogen, and saturating gradually with ammonia, the yellow matter undergoes some very curious changes of colour. Sometimes it passes first to dirty green, then to chocolate brown, then to red brown, and finally to blood red; sometimes it does not become green, but changes successively to orange yellow, chocolate brown, red brown, and blood red; sometimes it merely becomes orange yellow and then red. These variations depend on the relative proportions of the different bodies present; the final product is always uranium red, provided the sulphite of ammonia and the ammonia itself are not employed in too great an excess, in which case the transformation into uranium red is not effected, even by making the sulphuretted hydrogen act during an entire day, and sometimes the uranium passes into a stable solution, refusing to precipitate with the ordinary reagents. This curious phenomenon takes place when the sulphite of ammonia greatly predominates; in this case pentathionic acid is formed, with separation of free sulphur, and the liquid obtained, which contains the whole of the uranium, is coloured brown.

Immediately after the preparation of uranium red, the supernatant liquid, which should contain an excess of sulphuretted hydrogen, is completely limpid, but becomes gradually brown by contact with the air. This alteration commences at the surface of the liquid, and then descends; on reaching the red substance at the bottom of the vessel this substance also decomposes, becoming nearly black. Hence the first washings by decantation must be made quickly.

The more humid the substance the more beautiful and the brighter is its colour; after dessication and pulverisation its tone is duller. In any case its tint is rather lighter than that of uranium red obtained by the action of hydrosulphate of ammonia, and slightly approaches vermillion.

I have examined a product which during its preparation passed only through orange yellow as an intermediary tint. The substance has all the properties of ordinary uranium red, only it is attacked with more difficulty by carbonate and sulphite of ammonia. Submitted to the action of heat, a small quantity of hyposulphite of ammonia volatilises, as is the case with the uranium reds previously described.

The analysis of 100 parts of this uranium red has given 72.5 of uranium, 3 of sulphur, 0.74 of ammonia. It is impossible to discuss these results, especially as the sulphur and ammonia are in such small proportion. All that I can say is, that the product obtained by my process is probably a still more complex mixture than the uranium reds formed in hydrosulphate of ammonia.

The sulphite of soda also produces, in solutions of sesquioxide of uranium, a light yellow precipitate, which, when treated by sulphuretted hydrogen with the addition of a little caustic soda causes the formation of a uranium red. The product thus obtained is of the same colour as the others, but during washing it takes a brownish tinge.

By treating sulphide of uranyle, in presence of an excess of hydrosulphate of ammonia, by a current of sulphurous acid, no red matter is produced.

On account of their warm brilliancy the various uranium reds might be of great service in painting could they be preserved in oils. Unfortunately they gradually alter by contact with these liquids; the most persistent much resembles burnt sienna.

This alteration takes place less quickly with uranium reds directly prepared than with those obtained with hyposulphate of ammonia.—*Moniteur Scientifique*, vi., 469, 64.

On the Black Stones which fell from the Atmosphere at Birmingham in 1858, by Dr. T. L. PHIPSON, F.C.S., &c.*

THESE stones, which have hitherto been regarded as aërolites, fell at Birmingham in great number during a violent storm which broke over that town in the month of August, 1858. Several of these stones have been recently forwarded to me by Mr. W. P. Beale, in order that I might submit them to analysis.

They are small, angular, and black, presenting here and there a few indications of crystallisation. They act very slightly upon a magnetic needle, but the action is just sensible. They give a light coloured streak, and when finely pulverised are partially soluble in hydrochloric acid. Their specific gravity is about 2.7. They fuse with much difficulty upon the edges before the blow-pipe; when heated quietly in a platinum crucible they emit a marked odour of ozone. The analysis which I have made of them proves that these stones are *not* aërolites, but small fragments of basalt rock, analogous to that which exists at a few leagues from Birmingham near the parish of Rowley. They have given me:—

Silica	.	.	.	.	.	.	.	46.13
Alumina	.	.	.	.	.	.	.	16.25
Protoxide of iron	.	.	.	.	.	.	.	8.86
Peroxide of iron	.	.	.	.	.	.	.	3.71
Lime	.	.	.	.	.	.	.	11.25
Magnesia	.	.	.	.	.	.	.	6.74
Alkalies (by difference)	.	.	.	.	.	.	.	3.76
Water	.	.	.	.	.	.	.	3.30
								100.00

It is evident to me that those stones which fell in great numbers in Ann Street and other adjacent streets of the town of Birmingham were carried there by a waterspout, as was the case, doubtless, for the curious fall of hay which I observed in London in June, 1861, and described in the *Comptes Rendus* of the Paris Academy; and for the fall of iron stone which occurred in August, 1841, at Iwan, in Hungary; the size of the pieces of this iron stone which fell varied from that of a hemp seed to that of a nut. The black stones which fell in Birmingham are about the size of nuts; to judge from those forwarded to me.

TECHNICAL CHEMISTRY.

On a New Method of Extracting Gold from Auriferous Ores, by Dr. CRACE CALVERT, F.R.S.*

AT the present time, when the auriferous ores of Great Britain are attracting public attention, it may be advantageous to persons interested in gold mining to be made acquainted with a new and simple method of extracting gold from such ores, which presents the advantages of not only dispensing with the costly use of mercury, but

* Read before the British Association Bath meeting, and communicated by the author.

of also extracting the silver and copper as well as the gold which the ore may contain. Further, it may be stated that the process can be profitably adopted in cases where the amount of gold is small, and the expense of mercury consequently too great. Without entering here into all the details of the numerous (about one hundred) experiments which I made some years since, before I finally arrived at the new method of extracting gold, which I have now the honour of communicating to the meeting, allow me to state a few facts which are necessary to give a general view of the subject. If 2.2 parts of pure and finely divided gold, obtained by the reduction of a salt of that metal, be added to 100 parts of pure sand, and placed in a bottle with a saturated solution of chlorine gas for twenty-four hours, only 0.5 of gold is dissolved. If the same experiment be repeated, but, instead of chlorine water, a mixture of chlorine water and hydrochloric acid be used, 0.6 of gold is dissolved. If, instead of employing hydrochloric acid and chlorine gas, a mixture of sand, reduced gold, and peroxide of manganese, with hydrochloric acid, are placed in a bottle, 1.4 of gold is dissolved; so that it would appear that, under the influence of nascent chlorine, the gold is more readily dissolved than when the same gas is mixed in solution with hydrochloric acid previously to being placed in contact with the auriferous sand. Still these processes leave a great deal to be desired in a commercial point of view, as more than a third of the gold remains undissolved; and the same results are obtained if the chlorine gas be generated by another method, viz., by adding to the auriferous sand a mixture of chloride of sodium, sulphuric acid, and peroxide of manganese. Being convinced, therefore, that nascent chlorine gas was a fit and proper agent for cheaply extracting gold from ores, and that it was only necessary to modify the method of operating, I allowed the mixture of hydrochloric acid and peroxide of manganese, or of sulphuric acid, peroxide of manganese and chloride of sodium, to remain for twelve hours in contact with the auriferous sand; and then, instead of washing out the solution of gold, I added a small quantity of water, which removed a part of the acting agent, and this was made to percolate several times through the sand; by which method I succeeded in extracting from the sand, within a fraction, the whole of the gold. I then repeated the last experiments with natural auriferous quartz, and easily extracted the two ounces of gold per ton which it contained. I therefore propose the following plan for extracting the gold on a commercial scale:—The finely-reduced auriferous quartz should be intimately mixed with about 1 per cent. of peroxide of manganese; and if common salt be used, this material should be added at the same time as the manganese, in the proportion of three parts of salt to two of manganese. The whole should be then introduced into closed vats, having false bottoms, upon which is laid a quantity of small branches covered with straw, so as to prevent the reduced quartz from filling the holes in the false bottom. Muriatic acid should then be added if manganese alone is used, and diluted sulphuric acid if manganese and salt have been employed, and, after having left the whole in contact for twelve hours, water should be added so as to fill up the whole space between the false and true bottoms with fluid. This fluid should then be pumped up and allowed to percolate through the mass, and after this has been done several times the fluid should be run off into separate vats for extracting the gold and copper that may contain. To effect this, old iron is placed in it to

precipitate the copper; and after this has been removed, the liquor is heated to drive away the excess of free chlorine, and a concentrated solution of sulphate of protoxide of iron, or green copperas, is added, which, acting on the gold solution, precipitates the gold in a metallic form. By this method both gold and copper are obtained in a marketable condition. If silver is present in the ore, a slight modification in the process will enable the operator to obtain this metal also. It is simply necessary to generate the chlorine of the vitriol, manganese, and chloride of sodium process, taking care to use an excess of salt, that is, six parts instead of three, as above directed. The purpose of this chloride of sodium being to hold in solution any chloride of silver that may have been formed by the action of chlorine on the silver ore, and to extract the metal, the following alteration in the mode of precipitation is necessary. Blades of copper must be placed in the saline solutions, to throw down the silver in a metallic form, then blades of iron to throw down the copper, the gold being then extracted as previously directed. I think the advantages of this process are, 1st, cheapness; 2nd, absence of injury to the health of the persons employed; 3rd, that not only is the metallic gold in the ore extracted (as is done by mercury), but it attacks and dissolves all gold which may be present in a combined state, besides enabling the miner also to extract what silver and copper the ore may contain. I cannot, however, conclude without reminding you of what is generally underrated—that is, the heavy expenses which attend the bringing of the ore to the surface, its crushing and preparation to render it in a proper state for being acted upon either by mercury or by any other agents.

Second Report on the Application of Gun-Cotton to Warlike Purposes.* By a COMMITTEE, consisting of W. Fairbairn, LL.D., F.R.S.; Joseph Whitworth, F.R.S.; James Nasmyth, C.E., F.R.A.S.; J. Scott Russell, C.E., F.R.S.; John Anderson, C.E., and Sir W. G. Armstrong, C.B., LL.D., F.R.S., from Section G.; and J. H. Gladstone, Ph.D., F.R.S.; Professor W. A. Miller, M.D., F.R.S.; Professor E. Frankland, Ph.D., F.R.S.; and F. A. Abel, F.R.S., from Section B.

YOUR Committee on the Application of Gun-Cotton to Warlike Purposes has simply to relate the circumstances that have taken the matter out of their hands. When the Committee was re-appointed at the Newcastle meeting, another recommendation relating to gun-cotton was passed by the Association—namely:—

“That it appears from the Report presented at this meeting by the joint committees of chemical and mechanical sections, and by the discussions which have followed its presentation, that the subject of gun-cotton is possibly one of very great interest and public importance; and that whilst the General Committee have taken measures to continue on their own account the inquiries which have been presented in the last year, they are sensible that the British Association does not possess means for its adequate examination; they are desirous, therefore, of drawing the attention of Her Majesty’s Government to the importance of a full and searching inquiry, conducted by a Royal Commission, into the various practical applications connected with the public service, for which this material may be suitable, and that with this view the Assistant General Secretary be requested to cause

* Presented to the members of the British Association, Bath meeting. Read before Section B.

the Report, with its accompanying documents, to be printed with as little delay as possible, and copies presented (accompanied by the resolution) to the Right Hon. the Secretary of State for War, by a deputation consisting of the President and Officers of the Association, accompanied by the Presidents of Chemical and Mechanical Sections."

In accordance with this resolution, as soon as the Report was printed, a copy was presented to Lord de Grey, at the War Office, by a deputation headed by General Sabine. This took place on December 11. Much interest on the subject was excited in many quarters, and a large number of the separate copies of the Report were asked for and circulated. In January the Government appointed—not a Royal Commission—but a Committee to investigate the subject in all its bearings. It consists of General Sabine as President, General Hay, Captain Brandreth, R.N., Commander Liddell, R.N., Colonel Boxer, R.A., Colonel Lovell, R.E., F. A. Abel, Esq., T. Sopwith, Esq., Professor W. A. Miller, Professor G. G. Stokes, and Dr. J. H. Gladstone, with Major Miller, R.A., as Secretary, representing thus—the army, the navy, military and civil engineering, as well as chemical and physical science, and comprising, as will be seen, three of the members of your Committee. The Messrs. Prentice, who were present at the Newcastle meeting, immediately established a manufacture of the article at Stowmarket, and which has furnished materials for many experiments on the use of gun-cotton for quarrying purposes. The Government Committee is already engaged in a systematic course of experiments relating to the manufacture and keeping qualities of gun-cotton, and its use in artillery, small arms, and engineering. Your Committee, therefore, consider that their work is accomplished, since the application of gun-cotton to military purposes is now in a fair way of being investigated with greater facilities and means than could have been at their disposal.

After the above Report had been read, Professor Abel said the subject of gun-cotton had occupied a considerable share of his attention during the past year, and he would give an account of such experiments as had been made on behalf of Government. He was happy to say that they had made considerable progress already in their researches, and it afforded him still more pleasure to be able to say that results of those researches had been of a satisfactory character. He dwelt particularly upon this fact, because it would not have escaped notice that the official reports published in France were very unfavourable. The experiments conducted by Messrs. Prentice, and by himself, proved that gun-cotton possessed a great superiority over gunpowder, both in the simplicity and safety of its manufacture. The adoption of simple precautions set aside almost the possibility of accidents. With regard to a second point—the uniformity of manufacture—it was one upon which he had endeavoured to obtain the most precise information. He found that they might rely upon the Austrian system of manufacture. The next, and most important branch of inquiry, in connexion with the properties and uses of gun-cotton, was the question of its permanence or stability. Its properties, as a material for military engineering, would be rendered nugatory if they could not place the most perfect reliance upon it. According to some persons they ought to place no reliance on gun-cotton, because it was liable to change and spontaneous decomposition. He had looked at the reports of the French chemists, and he was bound to say that, although those experiments had been conducted with great care by almost the highest authorities, he could not agree

with them. He had at the present time a number of experiments in progress to ascertain the changes made by heat and exposure to light.

Upon the occasion of this Report being read in the Mechanical Section, Mr. Scott Russell stated that General Hay, of the Hythe School of Musketry, had constructed a new form of cartridge suited for the Whitworth rifle; that he had found the use of gun-cotton was clean, and had not the disadvantage of fouling the gun; that it had much less recoil, although the effect was the same; that one-third of the weight of charge was the equivalent proportion, and that it did not heat the gun. He had seen a gun fired at a target with gun-cotton from the shoulder of the general at 500 yards. Twelve successive shots were all placed in a space one foot wide, by two feet high, and the value of the practice was measured by the fact that the mean radius of deviation from the centre was between nine and ten inches. Thus, therefore, the use of gun-cotton in musketry had been proved by English-made gun-cotton in English rifles by an English general, to perform all that the Committee last year reported of Austrian gun-cotton on the faith of the Austrian General Lenk. The next application made during the past year was to the driving of tunnels, shafts, and drifts in connexion with engineering applications. It was stated by the Committee that one-sixth of the weight of charge of cotton was equal in blasting effect to gunpowder, and this had been proved in practice in a number of instances. At Wingerworth colliery one-thirteenth of the weight of gun-cotton as compared to gunpowder; in the slate quarries of Llanberis, at Allen Heads, one-seventh was required. At Allen Heads, at some lead mines, a canal was being driven seven miles long. The drift was seven feet by five in the hardest limestone. Both ends were worked by gun-cotton fired by an electric battery. The great advantage experienced was that the air was not contaminated by smoke, and that the work could be carried on more rapidly. The next application had been made to the detaching of large masses of rock. This had been tried in several places, and it was found that one pound of gun-cotton was able to detach from thirty to sixty tons of rock. The Government appointed a committee, naval, military, and civil—engineering as well as chemical and physical science, and that committee was already engaged in a systematic course of experiments relating to the manufacture and keeping qualities of gun-cotton, and its use in artillery, small arms, and engineering.

PHARMACY, TOXICOLOGY, &c.

On the Preparation of an Improved Wine of Iron,
by H. N. DRAPER, F.C.S., and Mr. J. WHITLA.*

THE authors first described their observations of the action of light in promoting decomposition of the official wine of iron. To prevent this decomposition, which occurs even in the dark, they suggested that ammonio-citrate of iron should replace potassio-tartrate, and that citrate of ammonia should also be added, to prevent any slight precipitation that might otherwise occur when the wine was exposed to strong sunlight. The formula proposed was as follows:—

Ammonio-citrate of Iron	160 grains.
Crystalline citrate of Ammonia	60 „
Sherry	1 pint.

The wine thus prepared was perfectly transparent, and had no disagreeable taste.

* Read at the meeting of the British Pharmaceutical Conference.

*On the Amount of Alkaloid in Commercial Citrate of Iron and Quinine, by Mr. J. C. BRAITHWAITE.**

THE author had examined fifteen samples of this medicine, which should contain 16 per cent. of quinine, or about 25 per cent. of citrate of quinine. The following is a tabular form of his results:—

			In 100 parts.	
			Quinine.	Citrate of Quinine.
1	.	.	1.5	2.3
2	.	.	1.5	2.3
3	.	.	3.7	5.8
4	.	.	4.1	6.4
5	.	.	4.7	7.4
6	.	.	6.0	9.3
7	.	.	7.3	11.5
8	.	.	9.3	14.5
9	.	.	11.2	17.5
10	.	.	12.2	19.1
11	.	.	13.0	20.2
12	.	.	14.7	23.0
13	.	.	14.8	23.1
14	.	.	14.9	23.2
15	.	.	15.8	24.7

On a New Method of Detecting Arsenic, Antimony, Sulphur, and Phosphorus by their Hydrogen Compounds when in Mixed Gas, by W. BIRD HERAPATH, M.D., F.R.S. L. and E.*

DR. HERAPATH having to investigate a case of suspected poisoning by phosphorus, in which the traces of free phosphorus had disappeared, during the long interval between administration of the poison and analysis, he examined for phosphorous acid by Scherer's method, but as several of the hydrogen compounds of sulphur and arsenic, for instance, have the property of blackening the salt of silver, he eliminated these hydrogen compounds from the gas before its absorption by ammoniacal nitrate of silver, or tested the gas as it was being evolved from any of their compounds. Dr. Herapath dissolved the organic matter, stomach, intestines, and contents in dilute hydrochloric acid by heat. The room of operation being at the time quite dark, an apparatus was fixed for exhibiting any phosphoric flashes of light, as in Mitscherlich's experiment: no flashes appeared. The acid solution might, however, have contained arsenic, phosphorus as phosphorous acid, antimony as chloride, and sulphur as taurine, &c. No chlorate of potassa could be employed in oxidising the organic matter, as phosphorous acid would become phosphoric, and all evidence be lost, for sulphates and phosphates are not reducible in the hydrogen apparatus; to the liquid filtered there was added one-third of spirit of wine, and it was then ready for use. A gas evolution bottle with funnel and pipe, armed with a tube containing chloride of calcium, and chalk in coarse powder, for the preparation of pure hydrogen gas, was got ready and tested, as usual, for arsenic. To the exit lamp was attached a green glass tube, well supported, passing over two or three spirit-lamp fumes. The exit pipe was bent at right angles, to go through a wide-mouthed bottle, containing slips of white filtering paper, dipped in a solution of nitro-prusside of sodium, made alkaline by ammonia, from which the gas was carried to the next bottle, containing ammoniacal nitrate of silver; and there was another exit tube leading to a bottle of some salt of lead, or this may be replaced by a jet for burning

the gas. The apparatus being at this period ready for use, pure zinc sulphuric acid and distilled water were placed in the hydrogen evolution bottle, and the stream of gas allowed to escape through the apparatus, heat being applied to the tubes with spirit-lamps. Now, if arsenic had been present it should have produced a crust in the usual place, and antimony would, if present, have been deposited at a spot near it. Whilst sulphur would partly have been sublimed and deposited in front of the arsenic, and the remaining undecomposed sulphuretted hydrogen gas would have communicated a deep purple blue tint to the paper charged with the ammoniacal nitro-prusside of sodium. Whilst the phosphoretted hydrogen, passing unchanged through all these tests, would have been at once seized by the ammoniacal nitrate of silver, and have produced the black phosphide of silver, whilst the hydrogen escaped through the lead solution without changing its colour, unless the evolution (supposing phosphorus to be present), of phosphoretted hydrogen would have been too violent for the perfect reaction of the silver salt. It was now possible to examine the prepared organic liquid with this apparatus, by inserting it in quantities of only a few drachms at a time into the hydrogen bottle, through the tubulated funnel, and by employing sufficient spirit, no frothing took place to endanger the success of the experiment, but should it occur it could at any moment be checked by the addition of a little spirit down the funnel. Did the tubes show no deposit, and if the paper remained white, neither arsenic, antimony, nor sulphur could be present. The black precipitate in the silver bottle would inferentially have been phosphide of silver, but it admitted of absolute proof by testing with Scherer's process. The operation being completed, the silver salt was passed through a filter previously washed with acetic or nitric acid, and afterwards with ammonia, and the collected black precipitate submitted to proof by burning the filter paper, acting on the ashes with nitric acid and heat until oxidised, the silver precipitated by pure hydrochloric acid, and the solution filtered. It contained all the phosphorus as phosphoric acid, which could be tested by the nitrate or chloride magnesium with ammonia, whilst the characteristic crystals of triple phosphate ammonia and magnesia should be examined in the microscope and identified by the action of polarised light and by the measurement of their angles in the goniometer, or the phosphoric acid may be tested by a solution of nitrate of silver with ammonia, when the yellow phosphate of silver would be obtained, and the blue phosphate of iron with a solution of its proto-salt. An objection might be raised to the testing of the ashes of a filter, as the fibres of paper might contain phosphate, which an acid washing would not remove, but which could be found after incineration by the same method. It was, therefore, better to burn the phosphoretted hydrogen, and condense the phosphoric acid vapour, and test the liquid for that acid by the above method. A single drop of dilute solution of phosphorus and phosphoric acids furnished abundant evidence of crystals of the ammonia and magnesium salt when a glass slide with a drop of distilled water on it had been inverted for a few seconds over its flame. When combustion of the gas is to be the method of proof, the silver solution should be removed to a small hard glass jet inserted in the end of the tube from the ammoniacal nitro-prusside of sodium bottle; the gas being inflamed may be treated as above, but to get sufficient evidence of minute traces of phosphorus it would be well to burn the gas in a glass globe, kept cool by

* Read at the meeting of the British Pharmaceutical Conference.

* Read at the British Association Bath meeting. Communicated by the author.

damp cloths round it, and the issuing stream of gas passed through a perpendicular tube surrounded by a freezing mixture, and the condensed water collected in a bottle by Mitscherlich's process, then by washing out the bottle, tube, and globe with distilled water, and concentrating by evaporation, it may be tested as before.

PROCEEDINGS OF SOCIETIES.

CANTOR LECTURES.

"On Chemistry Applied to the Arts." By Dr. F. CRACE CALVERT, F.R.S., F.C.S.

LECTURE VI.

DELIVERED ON THURSDAY EVENING, APRIL 28, 1864.

Flesh, its chief constituents, boiling and roasting. *Animal black*, its manufacture and applications. Various methods of preserving animal matters. Employment of animal refuse in the manufacture of *prussiate of potash*. A few words on the decay of organic matters, and their fermentation and putrefaction.

(Continued from page 129.)

I SHALL now examine with you some of the various causes which contribute to the destruction of animal matters, when it arises from slow decay or putrefaction. The first of these to which I shall have the pleasure of calling your attention is that observed by Dr. Stenhouse, who, in 1854, made the curious discovery that, if the body of an animal was buried in a carbonaceous mass, such as charcoal, after a few months the whole of the animal, excepting the skeleton, would entirely disappear; and what was still more remarkable was that, though the experiments were conducted within his laboratory, no unpleasant effluvia were apparent to those who were constantly there. This eminent chemist attributed the rapid and complete destruction of animal tissue in these experiments to the oxidation of the animal matters by the oxygen of the atmosphere; but to enable you fully to understand how this occurs, I must call your attention to the following facts:—Lowitz, many years since, observed that charcoal possesses the property of absorbing and condensing in its pores large quantities of various gases, and Theodore de Saussure made an extensive series of experiments, from which I extract the following data:—

One cubic inch of boxwood charcoal absorbed of—

Ammonia	. . .	90	cubic inches.
Hydrochloric acid	. . .	85	" "
Sulphurous acid	. . .	65	" "
Sulphuretted hydrogen	. . .	55	" "
Carbonic acid	. . .	35	" "
Oxygen	. . .	10	" "
Nitrogen	. . .	7	" "

Consequently the absorption or condensation of a gas in charcoal appears to be in ratio to the solubility of the gas in water, and although the condensation by a solid and by a liquid may at first appear necessarily due to different causes, and therefore to bear no relation to each other, yet in my opinion these two actions are identical. Seeing that the gas is condensed by the molecular attraction of the solid, I do not see why the same attraction should not be exercised by the molecules of the liquid. The different degrees of solubility of various gases are no doubt owing to their respective physical properties, such as specific gravity, repulsive or expansive forces of their molecules, &c. I may here mention that I am now engaged in a series of experiments, in the hope of throwing some light on this interesting question.

Gay-Lussac, in his researches on the condensation of gases by charcoal, found that one gas may expel and take the place of another gas already condensed in the charcoal; and Dr. Stenhouse, following up this observation, states that the gases, vapours, and sporules generated by the putrefaction of animal substances are absorbed by char-

coal and brought into immediate contact with the oxygen of the atmosphere also contained in the pores of the charcoal, while oxidising or destroying the products of putrefaction converts them into water, carbonic acid, nitric acid, &c. These important scientific observations of Dr. Stenhouse have already received practical application. Thus Mr. Haywood has established charcoal filters at the mouths of public drains, thereby arresting the escape and diffusion in the atmosphere of the noxious effluvia given off by the putrefying matters in the sewers. Further, charcoal respirators have become extensively used since Dr. Stenhouse called public attention to the valuable properties of this substance; and lastly, atmospheric filters, containing charcoal, have been successfully applied in the Houses of Parliament to purify the entering air from any noxious gases it may contain before passing into the building. The natural decay or destruction of organic matters is due to two perfectly distinct causes—one of them chemical and the other physiological. The former has been investigated by many of the most eminent chemists of the day, and no doubt can remain that the action of the oxygen of the atmosphere converts the carbon of organic substances into carbonic acid, the hydrogen into water, the sulphur into sulphuric acid, the nitrogen into nitric acid, the phosphorus into phosphoric acid, &c. Much light has recently been thrown upon these phenomena by M. Kuhlmann, who clearly shows that the oxides of iron play a most important part therein; thus that the sesquioxide of iron yields its oxygen to the elements of the organic matters; that the protoxide of iron thereby formed absorbs oxygen from the air, which reconverts it into sesquioxide, and this again yields its oxygen to a fresh portion of organic matter, so that sesquioxide of iron is a most powerful oxidising agent, it being, in fact, the condenser of oxygen and the medium of its conveyance to and destruction of organic substances. MM. Chevreul and Kuhlmann have also shown that sulphate of lime acts in a similar manner—namely, that it yields its oxygen to the elements of organic substances, and is thus converted into sulphuret of calcium, which having a great affinity for oxygen, is again rapidly converted into sulphate of lime, and thus the oxygenation and destruction of the organic matter is effected. Mr. Millon has published an interesting paper on the formation of nitre, or nitrate of potash, through the ammonia generated during the destruction of organic substances being oxidised into nitric acid, which combines with potash, if present, and if not with lime or magnesia, which are present in all soils. Mr. Millon has remarked that this important chemical reaction is effected by an organic substance called humic acid, which acid, or its homologues, exists in large quantities in all earthly loams containing much organic, and more especially vegetable, matters in a state of decomposition. Humic acid absorbs the oxygen of the atmosphere, which oxidises the ammonia into nitric acid and water. The chemical theory of the destruction of organic matters through oxidation and their absorption of plants and re-conversion into the same substances from which they were derived, such as sugar, starch, gum, oil, essences, &c., or albumen, fibrine, gluten, caseine, &c., was greatly in favour a few years since, as it appeared to fulfil all the requirements of nature. It has, however, been greatly shaken by the beautiful researches of M. Pasteur on fermentation, putrefaction, and spontaneous generation, which proves clearly that these physiological actions play a most active part in the destruction of organic substances. This most skilful chemist has demonstrated that there is no such thing as spontaneous generation, and that the notion entertained by some physiologists, that if matter is placed in favourable circumstances as to heat, light, &c., and in a proper medium, it will become spontaneously animated, is undoubtedly erroneous, and that life in all instances proceeds from a germ or egg in which the vital principle is implanted by the Creator. He proves that life, even in

the most insignificant of microscopic creatures, always originates thus, and that there is no single instance of matter being animated by purely physical causes. Let me draw your attention to a few among many facts observed by M. Pasteur, proving that life is not a property of matter, like weight, elasticity, compressibility, &c., but is always the result of a germ even in its lowest development.

When arterial blood is carefully introduced from the artery into a clean vessel, and there brought into contact with oxygen, no fermentation or putrefaction of the blood ensues; and if the experiment is repeated, substituting for the chemically-prepared oxygen atmospheric air which has been passed through a tube containing pumice-stone and carried to intense heat, in this case also there is no putrefaction or fermentation; but if ordinary atmospheric air be used in the place of pure oxygen, or heated air, and left in contact with some of the same blood, this vital fluid will rapidly putrefy, which is doubtless owing to the presence in the atmospheric air of the sporules or eggs of micoderma and vibrios, or organised ferments, which give rise to the various chemical phenomena and changes of organic matters into products which characterise fermentation and putrefaction. The same results are obtained when fresh urine is substituted for blood, an important fact, proving that the germs of fermentation do not exist in the fluids themselves, and that fermentation does not proceed from any molecular or chemical change in the composition or nature of the organic substances contained in blood and urine, but that the ferment from which these phenomena proceed is to be sought for in the atmosphere. I shall substantiate this view by several other interesting observations made by M. Pasteur.

If some asbestos is heated to a red heat and plunged into a liquor susceptible of putrefaction, such as a saccharine liquor, no fermentation ensues; but if atmospheric air is passed through asbestos at natural temperature, and the latter then immersed in a similar solution of sugar, active fermentation soon takes place, proving that the atmospheric air has left on the surface of the asbestos sporules of the *mycoderma vini*, which being introduced with the asbestos into the saccharine fluid, originated the well-known alcoholic fermentation. Another beautiful series of experiments by M. Pasteur is the following:—He introduced into 60 small balloons a small quantity of a highly putrescible fluid, and after boiling the fluid in order to drive out the remaining air in the balloons by the formation of steam, he closed the small apertures, so that on cooling the steam condensed and a vacuum was produced. He then proceeded to open 20 of these balloons at the foot of one of the hills of the Côté d'Or, 20 others at the summit of the same (about 2000 feet high, and the remaining 20 at a point near Chamounix, and the following results were observed:—Of the first 20 balloons the contents of 15 entered into putrefaction within a few days; of the second 20 only 6; and of the third 20 only 2 gave signs of fermentation. These results, as well as some others published by M. Pasteur, prove that the sporules or germs of putrefaction and fermentation exist in all parts of the atmosphere, but more abundantly in the lower strata, which are necessarily in contact with great quantities of organic matter in a state of decay, and that these sporules become scarce in the upper regions, which are further removed from the source of pollution. Further, he has proved, as I stated in my last lecture, when speaking of the preservation of milk, that fluids extremely liable to fermentation or putrefaction may be prevented from entering into those conditions by heating them to 250° or 260°, a temperature at which the sporules cannot resist decomposition in the presence of water. M. Pasteur has advanced a step further in this interesting inquiry, for he has demonstrated that there are two distinct phases in putrefaction. In the first there are the vibrios produced in the bulk of the fluid containing animal matters in solution, and these microscopic animals unfold the

organic substances into more simple compounds; in the second phase, there are produced on the surface of the fluid cryptogams, which he calls mycodermis, and which absorb oxygen from the air, and oxidise the products developed by the vibrios. In the case of the fermentation of vegetable substances, such as saccharine matters, there are mycodermis (*Mycoderma vini*), which unfold them into, say alcohol and carbonic acid, while other mycodermis (*Mycoderma aceti*) are produced, and grow on the surface of the fluid, oxidising the alcohol into water and acetic acid. He therefore concludes that the animal vibrios and vegetable mycodermis exist abundantly in nature, and that they must be and are the most active causes of the destruction of vegetable and animal substances which have fulfilled their vital function on the earth, reducing them into water, carbonic acid, ammonia, sulphuretted hydrogen, &c., which, in their turn, become the foods of a succeeding generation of plants and animals. We may therefore truly say that death is life in the constantly reviving world.

M. Pasteur has observed another most curious fact connected with these microscopic beings—(I say microscopic, because it requires a most powerful instrument and high powers to distinguish them, and to ascertain that vibrios possess a vibratory motion while mycodermis are stationary)—this is, that vibrios are the only animals which can live in pure carbonic acid, and which are killed by oxygen even diluted with another gas. Oxygen is essential to the life of mycodermis, and some of them can also exist in carbonic acid. Lastly, M. Pasteur has noticed that if a very small amount of yeast is added to a saccharine fluid, the yeast will not materially increase in quantity, because the new generation which is produced lives on the remains of its parents; but if phosphate of ammonium or of lime and some sal ammoniac is added with the yeast, the latter will rapidly increase and occupy several times its original bulk. It is curious to observe that these microscopic cryptogams require the same kind of food as man. Thus they require nitrogenated food—so do we. They require mineral food, as phosphates—so do we. They require respiratory food—so do we. They produce carbonic acid as part of their vital functions—so do we. I cannot do better than conclude this part of my subject by giving the following table descriptive of the various ferments observed by M. Pasteur:—

FERMENTATION.			
Mycoderma vini.	Unfolds sugar.	{	Alcohol.
			Carbonic acid.
Mycoderma aceti.	Oxidises alcohol.	{	Succinic acid.
			Glycerine.
			Acetic.
			Water.

PUTREFACTION.

Infusorial Ferments.

Vibrios, unfold animal substances.

Bacteria, oxidises organic matters of an animal origin. I should mislead you, however, if I did not call your attention to another class of fermentations, which are chemical in their nature and in their action. This, for example, is the case when bitter almonds are crushed and mixed with water. The amygdaline they contain is decomposed into prussic acid, hydruret of benzoil, &c., by the ferment they contain, which is called emulcine. Again, when black mustard is reduced to meal, and placed in contact with water, the myronic acid it contains is decomposed into the essential oil of mustard, a most corrosive fluid, and this is also effected by a special ferment called myrosine. Again, when malt is mashed with water of a temperature of 170°, its starch is converted into sugar by a ferment called diastase. We also know that the starch which we take into our stomachs as food is converted into sugar by animal diastase, which exists in the saliva as well as in the pancreatic juice, and that this conversion is identical with that which takes place in the mashtub. In

fact, the whole of the changes which our food undergoes to render it fit for assimilation in the digestive organs of the body may be considered as a series of different fermentations. What gives a further interest to these chemical ferments is, that not only are they all nitrogenated, and possess a similar composition, but they present many identical properties, still each has its own peculiar action; that is, it will only cause fermentation in those matters which have been placed by nature in contact with it. Thus diastase will not convert amygdaline into prussic acid, hydruret of benzoin, &c., nor will myrosine convert starch into sugar.

In conclusion, it is certain that our knowledge of these interesting phenomena of putrefaction, fermentation, &c., is yet in its infancy, and there is no doubt that many important discoveries in this intricate branch of knowledge will from time to time be brought before the world, and reward science for its persevering efforts.

[This lecture concludes Dr. F. C. Calvert's course as delivered before the Society of Arts; on delivery they were listened to with eagerness by a numerous auditory, and have now been read with no less pleasure than instruction.—ED. C. N.]

ACADEMY OF SCIENCES.

September 19.

M. PASTEUR made a communication on the "*Phosphorescent Light of the Cucuyos*," coleopterous insects very common in Mexico. The light emitted by these insects is so intense that one will enable a person to read in the dark at a short distance from the animal. Mexican ladies ornament themselves for evening parties with the insects, keeping them for the purpose, feeding them on sugar, and giving them a bath once or twice a day. The light examined by the spectroscope gives merely a continuous spectrum, very beautiful, says M. Pasteur, but without lines. He made the same observation with the light of glow-worms.

M. Monier presented a note on the "*Assay of Animal Charcoal*." The deterioration of animal charcoal, according to the author, is attended with an increase of carbonate of lime, and a decrease of nitrogenised carbon in the charcoal. Thus, in fresh he found 5.1 per cent. of carbonate of lime, and 10.5 per cent. of this "nitrogenised carbon;" while a sample of exhausted charcoal contained 16 per cent. of chalk, and only 4 per cent. of nitrogenised carbon. We need not quote the author's process, which is simply estimating the moisture, chalk, and carbonaceous matter in the usual way. The amount of carbonaceous matter of course determines the value of the charcoal.

MM. de Luca and Ubaldini presented a paper entitled "*Chemical Researches on Asparagine Extracted from the Tubers of Stigmaphyllon Jatrophaefolium*," one of the Malpighiaceae indigenous in the Brazils. It seems to be identical with the asparagine from ordinary sources. The authors conjecture that asparagine may be found in almost any plants at a certain stage of their growth.

NOTICES OF BOOKS.

The Laboratory Guide for Students of Agricultural Chemistry. Arranged by A. H. CHURCH, M.A., Professor of Chemistry in the Royal Agricultural College, Cirencester. London: Van Voorst. 1864.

WHAT a plant feeds on, or rather, what is necessary to its growth, is now pretty generally known; how it feeds is another, and, though quite as interesting, to us at the present moment, a less important matter. When it is known what are the constituents of a plant, it is the agriculturist's business to see that all these are present in the

soil or supplied in the manure. Hence it is to the farmer's advantage to be a chemist. The fact is as yet but imperfectly recognised by the class, but still the students of agricultural chemistry are numerous, and continually increasing in number.

Mr. Church's book appears opportunely, since a work of the kind has been for some time wanted. The agricultural student has no necessity to make himself profoundly acquainted with analytical chemistry. The number of substances which require his attention is not large, and the object of the examination is always definite. Under these circumstances, he requires special and definite instruction, and it is this which Mr. Church has set himself to supply. After giving preliminary general directions for the detection of all the substances likely to be met with in agricultural materials and produce, which necessarily includes all but the rarer elements, the author devotes the remainder of the work to special methods for the quantitative analysis of soils, cattle foods, manures, and water, and a few examples of agricultural produce.

The former part of the work may be commended to all studying analysis for the admirable clearness and completeness of the instructions, and the book may be taken with advantage as a guide for junior students in all laboratories.

The second part, giving directions for the quantitative analysis of manures, soils, feeding materials, &c., contains all that the ordinary agricultural student requires, and we may content ourselves with recommending the work to all engaged in the study of agricultural chemistry.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2079. John Edward Grisdale, Cranbourne Street, Middlesex, "Improvements in apparatus for washing photographic prints."—Petition recorded August 23, 1864.

2088. Arthur Auckland Leopold Pedro Cochrane, Portsmouth, Hampshire, "Improvements in apparatus for heating and evaporating liquids and fluids."—Petition recorded August 24, 1864.

2116. Peter Armand le Comte de Fontainemoreau, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of artificial stone."—Petition recorded.

2137. John Stenhouse, Rodney Street, Pentonville, Middlesex, "Improvements in rendering certain substances less pervious to air and liquids, and also less liable to decay."

2143. Alexander Rollason, Old Kent Road, London, "Improvements in glazing and varnishing paintings, prints, and photographs, and which improvements are also applicable to plain paper, woven fabrics, leather, and other substances."—Petitions recorded August 31, 1864.

2150. Thaddeus Fowler, Seymour, Connecticut, U.S.A., "An improved method of coating pins and other articles with tin or other metal."—Petition recorded September 1, 1864.

2177. David Walker, Liverpool, Lancashire, "Improvements in arrangements for malting."

2178. Thomas Henry Baker and Thomas Woodroffe, Tonbridge, Kent, "Improvements in arrangements for malting."—Petitions recorded September 6, 1864.

2193. James Fleming, Glasgow, N.B., "Improvements in the treatment of tobacco leaf for the extracting of juice or liquor therefrom."—Petition recorded September 8, 1864.

2229. Robert Francis Fairlie, "Improvements in the manufacture of artificial fuel."—Petition recorded September 12, 1864.

2235. Alexander Carnegie Kirk, Bathgate, Linlithgowshire, N.B., "Improvements in the manufacture of ice."—Petition recorded September 13, 1864.

Notices to Proceed.

1092. Frederick Leisz, New Coventry Street, Leicester Square, Middlesex, "Improvements in the manufacture of syrups."—A communication from Jean Jaques Grosheinz and Auguste Sheurer, Longalback, near Colemar, Haut Rhin.—Petition recorded April 30, 1864.

1114. Edwin Henry Newby, Leicester, "Improvements in the manufacture of iron and steel."—A communication from Anthony Leonard Fleury, New York, U.S.A.—Petition recorded May 3, 1864.

1124. John Potter, Manchester, "A new compound or composition for artificial stone, and for certain machinery or apparatus to be used in mixing and applying the said composition."—Petition recorded May 4, 1864.

1136. Edward Beanes, Argyll Street, Middlesex, and Conrad William Finzel, Bristol, "Improvements in sugar boiling."—Petition recorded May 5, 1864.

1166. Henry Woodward, Euston Road, Middlesex, "Improvements in apparatus for carburetting gas."—Petition recorded May 7, 1864.

1173. Francis Herbert Wenham, Clapham, Surrey, "Improvements in motive power engines worked by explosive mixtures of gas or vapour."—Petition recorded May 9, 1864.

1192. James Brown, Aldgate, London, and Astley Paston Price, Lincoln's Inn Fields, "Improvements in the manufacture of blotting-paper."—Petition recorded May 11, 1864.

1211. Edward Myers, Millbank Row, Westminster, and Thomas Guy Rogers, Cambridge Street, Pimlico, Middlesex, "Improvements in wet gas meters."—Petition recorded May 13, 1864.

1228. Alfred Fryer, Manchester, Lancashire, "Improvements in treating animal charcoal in the process of revivification, and in apparatus employed therein."

1229. Louis Bricout, Reims, France, "Improvements in apparatus employed in carburetting gas."—Petitions recorded May 14, 1864.

1270. Joseph Freeman, Edward Grace Freeman, and Charles Henry Freeman, Battersea, Surrey, "Improvements in treating oil and spirit varnishes, and also drying oils and turpentine, in order to bleach and otherwise improve the same."—Petition recorded May 19, 1864.

1374. William Clark, Chancery Lane, Middlesex, "Improvements in the mode of treating animal, vegetable, and mineral matters, whereby to effect their dessication, vaporisation, decomposition, reduction, fusion, or volatilisation, and in apparatus for the same."—A communication from Henri Adolphe Archereau, Boulevard St. Martin, Paris.—Petition recorded June 2, 1864.

1386. William Clark, Chancery Lane, London, "Improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive driving power."—A communication from Jean Henry Cazal, Boulevard St. Martin, Paris.—Petition recorded June 3, 1864.

1401. James Napier, Glasgow, Lanarkshire, "Improvements in separating certain metals and metallic substances from ores and other matters."

1408. William Clark, Chancery Lane, Middlesex, "Improvements in the preparation of phosphates of ammonia and ammoniaco-magnesian phosphates."—A communication from Emmanuel Adrien Lesieur, Boulevard St. Martin, Paris.—Petition recorded June 6, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, September 27.

M. TRIBAUT, a French mining engineer, has lately discovered a very rich vein of cobaltiferous copper, containing nearly 9 per cent. of oxide of cobalt, near Oviedo, in Spain. He has entered into an agreement with an English

house to take nearly the whole produce of his mines. When will the minerals of Spain receive the attention they want from English mining engineers? The wonderful display of minerals shown in the Spanish department of the International Exhibition of 1862 seemed to indicate that Spain is richer in mineral products than any other country in Europe, and yet how few mines are worked. I fancy if any of your numerous mining engineers were to spend a holiday in Spain amongst the mineral districts, he would be amply repaid by many profitable discoveries.

The Abbé Moigno, the indefatigable editor of *Les Mondes*, has in his possession at the present moment several living specimens of the Mexican fire-fly, which have been sent to him from that country. He exhibited them at the last meeting of the Academy, before which M. Pasteur had submitted the light given out by these beautiful creatures to spectral analysis, and finds it free from lines. It differs from solar light only by the yellow portion of its spectrum being of slightly greater extent. The benevolent Abbé has been besieged for the loan of his insect treasures by several duchesses and countesses, who are anxious to put them to the same use as the Mexican ladies. As it seems possible to preserve these creatures for a considerable length of time, and as Mexico is now in constant communication with Paris, some enterprising artificial florist will no doubt next season import them regularly for the use of the Parisian belles.

M. Texier, one of the editors of the *Siècle*, is exceedingly wroth that M. Robin, the renowned *prestidigitateur*, has not received, at any rate, some part of the 50,000 francs prize awarded to M. Ruhmkorff, "the theatre of M. Robin," says M. Texier, "having certainly contributed more towards the popularisation of the induction coil than either the Academy of Sciences or the Sorbonne." *Apropos* of this wonderful assertion, M. E. St. Edmé falls foul of M. Texier in the last number of the *Cosmos*, and administers to him a well-merited castigation. Were M. Texier in London, I suppose he would place Mr. T. Matthews, the clown, and his hot poker by the side of Tyndall and his wondrous Royal Institution experiments.

The strictures of Mr. W. B. Tegetmeier, on the fictions and absurdities of the *Times*' "Bee-master," have been republished in several of the scientific journals here, and have aroused the laughter of the French apiarians, who innocently ask how it happens that the great English journal could allow such nonsense to be published in its columns.

The Italian papers announce that Professor Marini, a naturalist of Sardinia, has discovered a method of petrifying human bodies. It is stated that he has already made a table from petrified brain blood and bile, which has all the appearance and consistence of breccia. Fancy sitting daily on your grandfather and dining off your grandmother, while your wife and children sit round on your deceased brothers and sisters! Or, still better, imagine paving your hall with your enemies in neat squares, with appropriate inscriptions on each. It is also said that M. Marini is coming to Paris to show the Parisians how for the future every man may be his own tombstone.

On the Solubility of Gold in Nitric and Sulphuric Acids.

To the Editor of the CHEMICAL NEWS.

SIR,—Since sending you the note on the solubility of gold a chemist of my acquaintance has informed me that the information given was not sufficient to enable him to perform the experiment satisfactorily. I therefore send you a more complete account of the experiment performed by me.

The alloy of silver and gold was exposed to the action of nitric acid until the gold was left in a powder. On heating this powder with sulphuric acid a yellow solution was obtained, which, when poured into water, gave a purple precipitate. This at first led me to suppose that

the sulphuric acid had dissolved some gold; so after washing, the gold was heated for some time with strong sulphuric acid, without any solution taking place; but on adding a little nitric acid an immediate yellow colour was observed in the liquid, and on pouring it into water the same blue precipitate was obtained. The experiment has been repeated, and the acids were of course tested to ascertain their purity; but the solution contains the gold evidently in a different state of combination from that produced by dissolving in nitric and hydrochloric acids, for it is again precipitated by water.

A tenth of a grain was easily dissolved in this manner; but had the heat been continued no doubt a larger quantity would have been obtained in solution. I am, &c.

ARTHUR REYNOLDS.

Excise Chemistry.

To the Editor of the CHEMICAL NEWS.

SIR,—The publication of Mr. Phillips' report with the announcement of the detection of coculus indicus and grains of paradise in several samples of beer induces me to ask if you know a satisfactory test for the presence of these bodies? With regard to the first, I may say that all the processes which I have tried fail to prove the presence of picrotoxine, even when it has been purposely added; for the second I do not know any test.

Another passage in the Report is somewhat amusing. Mr. Phillips has found two tinctures made with methylated spirit. Perhaps it may be news to him to be told that all the tinctures in the Pharmacopœia are made with methylated spirit, and wholesale druggists regularly advertise them in their price lists.—I am, &c.,

A CHEMIST.

MISCELLANEOUS.

British Association.—At the final meeting of the General Committee, Mr. Galton read the list of recommendations which do not involve grants of money, and of which the following are the more important, relating to chemistry and physical science:—

“That Professor Stokes be requested to continue his report on the present state of physical optics.

“That Professor Griffith and Dr. Aikin be requested to continue their report on the transmutation of spectral rays.

“That Dr. Paul be requested to draw up a report upon the application of chemistry to geology.

“That Dr. Baker Edwards be requested to make experiments and report upon the alkaloidal principles of Calabar beans.

“That the Committee on gun-cotton be requested to continue their reports.”

The following recommendations of grants of money were also read and confirmed:—

Chemistry.

Matthiessen, Professor—Chemical Constitution of

Cast Iron 30 0

Gages, M.—Mechanical Structure of Rocks .. 20 0

Catton, Mr.—Analysis of Organic Acids .. 20 0

Williamson, Professor—Analyses of Gases of Bath

Waters 20 0

Wanklyn, Professor—Hexylic Compounds .. 20 0

Separating Ores from their Gangues.—Mr. W. Clarke has patented an apparatus for separating auriferous, argentiferous, and other ores from their gangues, which is distinguished from those ordinarily used by the separating process commencing at the lower part, the gangues passing in an upward direction. It consists of a cylindrical receiver of metal mounted on a frame, with a hollow axis passing down its centre, and to the lower end are applied the wings or blades receiving rotary motion from bevil wheels mounted at the upper part of the appa-

ratus. The ore to be separated is received in a hopper at the top of the apparatus, which may have an oscillating motion imparted to it; a jet of water is also introduced for the purpose of carrying the ore down into the cylinder. The ore is conveyed through the hollow axis to the lower part of the apparatus, where it is acted on by the blades, which in rotating produce the separation of the gangues and cause them to enter two compartments forming a double casing round the inner chamber. The cylindrical chamber, as also the outer casing, should be completely filled with water; suitable cocks and a manhole are applied at the bottom part of the receivers, the gangues passing out of the cocks of the outer casing, while the rich ore is withdrawn by means of the manhole.—*Mining and Smelting Magazine.*

Erosion of Lead by Insects.—A letter to the *Times*, signed “Y,” states that the erosion of lead by certain species of insects is not generally known, and may be extremely mischievous. Not long ago it attracted the attention of the French Academy of Sciences, and several communications upon it have been published in their proceedings, the *Comptes Rendus*. In 1858 Marshal Vaillant exhibited to the Academy leaden bullets brought back from the Crimea, in some of which the larvæ of insects had excavated circular passages three or four millimetres in diameter; but nothing of the kind had been detected in the cartridges of the Russian army in the Crimea, and the insect which damaged the French cartridges appears to have been imported in the wood of the cases in which they were packed. The insects do not eat the lead, but simply bore it out. In 1833 Audouin exhibited to the Entomological Society of Paris sheet lead from the roof of a building deeply grooved by insects. In 1844 Desmarest mentioned erosions of sheet lead by a species of *Bostriche* (*B. Capucina*), and illustrated the fact by cartridges from the arsenal at Turin. Mr. Westwood, the well-known British entomologist, has recorded observations on the perforation of lead by insects. M. Bouteille, curator of the Museum of Natural History at Grenoble, sent to the French Academy of Sciences from the collection under his charge specimens of cartridges gnawed by insects, which were found *in situ*, and the reports on the subject by Marshal Vaillant, de Quatrefages, and Milne Edwards, state the insect to be *Sirex gigas*, a large hymenopterous species, which, in the larva state, lives in the interior of old trees or pieces of wood, and which, after the completion of its metamorphosis, quits its retreat for the purpose of reproduction. Scheurer-Kestner, in 1861, communicated to the French Academy a notice of the erosion by an insect of the sheet lead of a new sulphuric acid chamber. The creature was caught in the act of escaping through the lead, having been imprisoned between it and a wooden support. But perhaps the most interesting and important case of insect erosion is that of stereotype metal, which was communicated in 1843 by M. du Boys to the Agricultural Society of Limoges.

ANSWERS TO CORRESPONDENTS.

* * All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

An Old Subscriber will find the information in the *Public Ledger*. J. Whitfield.—You can procure either through Morgan Brothers, of Bow Lane, or Sampson Low and Co., of Ludgate Hill. Dr. Attfield.—Received, with thanks.

THE BRITISH PHARMACEUTICAL CONFERENCE AND THE SALE OF POISONS.

THE meeting of the Pharmaceutical Conference at Bath may be described as a decided success. A large gathering of chemists and druggists can never be expected; but we have no doubt the proceedings of the Bath meeting will conduce to the attendance of larger numbers at meetings yet to come. The abstracts of the papers we have published show that the attention of the members was, for the most part, directed to practical matters, on which they furnished sound and useful information.

But the meeting was in other respects opportune. The recollection of a recent trial was fresh in the minds of the members, and the Medical Officer of the Privy Council had just made a report of some interest to the trade. It was not surprising, then, that the sale and dispensing of poisons should occupy a large share of attention. Mr. Deane, the president, devoted a considerable part of his opening address to the subject, and we have great pleasure in publishing to-day most of the observations he made.

In the first place, the *trade* (we hope no one will take offence at our use of the term) were fortunate in having Mr. Deane for a mouthpiece on the occasion. As the proprietor of one of the best businesses in London, as a man of known scientific attainments, and as a gentleman of high character, he is particularly well placed to defend the interests of his class; and the remarks he made on the position of the chemist and druggist and the operation of Lord Campbell's Act will be read with approval by every member of the trade. The operation of this Act on the chemist and druggist, as illustrated in the Liverpool case, is particularly hard; but we very much doubt whether public opinion will allow of any alteration of the law. Under these circumstances the custody of dangerous medicines becomes one of the most important considerations. We strongly advocate the segregation of all such articles in the *repertorium toxicorum* suggested by the Committee of the Conference. The objection usually made against this system—namely, that patients, seeing a prescription made up with ingredients from a "Poison Cupboard," would often refuse to take the medicine—is by no means fanciful.

Within our own knowledge, patients who have made out the words "arsenic" and "strychnia" in their prescriptions have absolutely refused to swallow a dose. This, however, is a matter for the prescriber's consideration, who is seldom considerate to the chemist. Let the chemist, therefore, take care of himself, and spare no pains to make poisonous remedies conspicuous either by locking them up, or by giving to the vessels containing them as eccentric an appearance as possible. We may, in fact, endorse all the suggestions of the Committee on "shop arrangements" and "dispensing," as well as those on the sale of such poisons as must be retailed. Many accidents will no doubt be prevented by adopting them; but if not, the chemist will have the satisfaction of knowing that he has done all in his power to prevent mischief. But what care that a druggist could take, or what Act of Parliament could prevent such accidents (!) as those related by Mr. Deane from his own acquaintance, to which we might add some others from our own experience?

We intended to make some remarks on the statistics of poisoning, as detailed in the Reports of the Conference Committee, and the Medical Officer of the Privy Council, but these we must defer until next week.

VOL. X. No. 253.—OCTOBER 8, 1864.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*On the Occurrence of Indigo in Purulent Discharges, by WILLIAM BIRD HERAPATH, M.D., Lond., F.C.S., F.R.S. L. and E., M.M.S.L., &c., &c.**

SOME time ago I had the pleasure of directing the attention of the members of the British Medical Association to the frequent presence of indigo, or of a substance which by oxidation became indigo, in the urine of patients who suffered from albuminuria, either as the result of Bright's disease of the kidney, or as a more scanty morbid product in that form of albuminuria produced as a sequela of scarlatina; and I brought forward two well-marked cases in which this peculiar colouring principle had been found by me in two patients who had been under my professional care. At that time it will be recollected by some of those who are now present, I obtained it in sufficient quantity to be able to exhibit it to the members, and even to demonstrate the crystalline character of the indigotine by preparing specimens of the sublimed crystals, which were very readily exhibited in the microscope, upon employing Ross's quarter objective for their examination. Since that period we have been instructed by Heller, Schunck, Virchow, and others that urine even in the healthy state contains a substance from which an indigo blue pigment may be obtained in traces, or excessively small quantities, and Kletzensky has shown us that the urine of the horse and the cow contains a comparatively large quantity of this pigment-forming substance; whilst the same observer has even discovered that the exhibition of creosote and oil of bitter almonds as medicinal agents appears to have the power of increasing the quantity of indigo obtainable from the urine of the patients who have been under treatment with these substances.

It is remarkable, however, that indigo very rarely appears to be eliminated directly from the body in its markedly blue colour; on the contrary, it is thrown off rather in the colourless form, or in the shape of indican or of uroxanthine, as its name imports, a light yellow substance, which upon treatment with acids splits up into three other substances, two pigments named uroglaucone or indigo blue, and urochrome indigo red, whilst a saccharine substance is also separated in notable quantity. So that uroxanthine may be considered as a glucoside, in which indigo blue and indigo red are present, but invisible as colouring matters, but capable of being produced by the action of fermentation, oxidation, or the destructive action of the mineral acids, as hydrochloric and sulphuric acids.

It will also, perhaps, be recollected by the members that even in the indigo plant the colouring material does not exist ready formed, but that it requires a peculiar process of fermentation and oxidation to be carried on in the expressed juices of the plant during a considerable period, in order to obtain this valuable blue in any quantity.

The occurrence of the vegetable product indigo in the fluids eliminated from the human body was considered an instance of the deterioration of the animal elements as remarkable as the presence of grape sugar in the blood and urine of diabetic patients, or the extraction of dextrine or hepatine from the liver, or the discovery of amyloid substance in the tissues of diseased organs. But it is now known that there are numerous proximate

* Read in sub-Section D, British Association, Bath.

principles, which, though usually obtained from the vegetable kingdom, are, however, common to both the animal and vegetable worlds; and I may instance:—Benzoic $C_{14}H_5O_2O$, and oxalic acids $C_4O_6_2HO + 4HO$; dextrine or gum, $C_{24}H_{20}O_{20}$; glucose, $C_{24}H_{21}O_{21}$; indigo blue, $C_{16}H_5NO_2$, indigo red, albumen, and other proteine compounds, together with fat and many of the fatty acids and their products of oxidation and decomposition. Now, pathologists and physiological chemists are tolerably well agreed that the source of the indigo-forming substance in the animal economy may probably be due to destruction of some of the proteine compounds, and more especially hæmatosin, the well-known colouring matter of the blood globules, for we invariably find that the blue pigment predominates in those diseases in which great destruction of blood pigment occurs, as in albuminuria, phthisis, scarlatina, and such like diseases which are productive of great and excessive anæmia.

In those cases in which I found indigo in the urine of patients suffering from granular kidney the blue pigment only developed itself after considerable delay in bottles partly filled, but corked. Under these circumstances, the urine underwent ammoniacal fermentation from decomposition of the urea, and the oxygen of the air in the bottle produced the blue deposit of indigo as a film upon the surface of the urine of a deep purple colour, but having a coppery tinge when examined in some angles of reflection.

This substance, when treated with potassa and protoxide of iron, with the assistance of heat, was readily deoxidised, and again changed into the colourless form of indigo so well known to calico printers and others in the habit of using this valuable dye; and, as I before observed, crystallised in six-sided plates and aciculæ of a deep blue colour when cautiously sublimed.

I am not aware that any observer has pointed out the presence of indigo in any other animal fluid than urine, although Carter has from certain reactions inferred the presence of indican in human blood. The following case, therefore, is one of peculiar interest, as I believe it is the first instance in which pus or its serous liquor puris has been shown to contain any blue pigment of this character.

The subject of the present case was a coachman, aged about 36, married, and the father of two children. He came under my care in the month of September last, and was then suffering from an enlargement of the knee-joint, but apparently without any fluid effused in the synovial membrane. The bones themselves were evidently enlarged, and a certain amount of fixtue appeared to exist, which made me almost apprehensive that ankylosis had taken place. This disease of the knee, however, did not make him incapable of walking, as he was able to come to my house from Bedminster, and he did not at that time complain of his knee at all. It gave him no pain or anxiety, as it had been of long standing, but he consulted me more especially for a large swelling over the gastrocnemius of the same leg, the left, which was, though tense, fluctuating, and it evidently contained fluid.

It was not painful on pressure, and did not look like an abscess, or as being the result of inflammatory action. It was punctured, and a large quantity of serous fluid poured out, together with some large white bodies, which at first sight appeared like hydatids, but were afterwards thought to be masses of fat, as no distinct hydatid structure could be discovered in them. The puncture was made by my assistant on August 20, during my temporary absence from home, and when I saw him for the

first time on September 7 the sac had again filled, and I removed a similar quantity of serum, together with another crop of these peculiar bodies. He walked home after both these little operations, and did not appear to suffer much inconvenience or pain. He called on me again on September 11, when the wound was enlarged, as more of these bodies appeared to be present, obstructing the opening and preventing the exit of the fluid from the sac. This sac was evidently in the substance of the cellular tissue over the gastrocnemius, as it was very superficial, and the puncture was made just on the inside of the calf. He was not seen again until the 16th, when the sac had decreased considerably in size. It was discharging well, and the opening was sufficient for all purposes, the man himself having squeezed out several more of these white masses every day since he saw me last. On September 21 he again called on me, when the swelling appeared in the same state as at the last visit, but he now complained of some enlarged glands in the femoral region, within Scarpa's triangle and below Poupart's ligament. These were somewhat tender to the touch and painful, for which he was directed to apply tincture of iodine freely twice daily. Shortly after this he became very much worse, and was seized with violent shivering fits, vomiting, and tenderness about the leg and knee, all of which he ascribed to the application of the iodine; but it was soon evident that he had an attack of violent phlegmonous erysipelas around the knee-joint, in the leg, and over the calf, which rapidly extended down even to the foot. Fluid continued to escape from the opening made in the sac, but it had now a decidedly purulent character, and the margins of the wound became very red, angry, and inflamed. During the course of the next week or more evaporating spirit lotions were used to keep down the temperature of the inflamed leg, and several large bullæ formed upon the dorsum of the foot, upon the calf, and under the ham. From these on bursting a sero-purulent fluid exuded in large quantities, and the discharge from the original wound was considerably increased. He had frequent startings and jumpings in the leg, which gave him intense agony, and his nights were sleepless unless he had strong morphia draughts or opium in some form or other. His leg was now so painful and swollen that he could not bear the least motion, and it was kept in one position—on its outer side upon a splint, and somewhat flexed at the knee. During three weeks he continued in this truly pitiable condition, and it was during this period that the cloths employed to keep his limb wet with spirit lotion, together with all the bed-clothes where the fluid had soaked through them, were found constantly tinged of a greenish blue colour, having very much the appearance of mouldy cheese, whilst the spirit and water used after a little time became equally greenish blue from having the cloths frequently wrung out in the vessel containing the dilute spirit, which was made by mixing gin with about four or five times the quantity of spring water. This peculiar colour gave me no alarm, for at first I was disposed to consider it as the natural mouldiness occasioned by the presence of microscopic fungi vegetating in the organic matters of the discharges, and I ordered some of the fluid to be saved for microscopic examination, fully anticipating that I should discover these minute plants without any difficulty.

But, to my very great surprise, I found no such organisms apparent, even with the higher powers of the instrument; whilst on repose, the bottle being full and corked, the blue colour disappeared in the course of a few hours. However, upon again taking out the cork,

and exposing to the air for a short time the blue colour was again developed—chiefly at the surface of the fluid. This experiment clearly proved that the phenomenon was due to some chemical action of oxygen upon a colourless material, analogous to indigo, in its deoxidised condition.

So upon treating the blue liquid with a solution of hypochlorite of lime or soda, the colour was immediately discharged as certainly as if indigo itself had been acted upon. When treated with an ammoniacal solution of acetate of lead, the whole colouring matter was precipitated in combination with the lead. And if filtered through paper, although some of the blue pigment was retained in the meshes of the paper, some passed through from the very fine state of molecular division in which the substance was; a further deposit took place after a time in the filtrate in consequence of the oxidation it had undergone from being so freely exposed to the action of oxygen during the process of filtration. By repeating this operation several times, sufficient material was obtained to furnish other evidence of the presence of indigo blue—namely, by its solubility in hot alkalis, deoxidised by sugar or protoxide of iron—and the volatilisation of the pigment and crystallisation of the substance when submitted to cautious sublimation. It is much to be regretted that the true nature of this substance was only discovered on the eve of its disappearance, or a much larger supply could have been readily obtained.

On changing the remedial measures to poultices, which became needful in consequence of the formation of numerous abscesses along the course of the saphæna vein, and in the ham, upon the dorsum of the foot, and round the ankle, the pus assumed the ordinary appearances, and the blue colouring matter was no longer found to develop itself; this might have been either from its having ceased to be formed, or from the poultices preventing that constant oxidation which was so essential for the production of the blue colour, from the originally colourless base.

These abscesses were very large, and discharged greatly for several weeks; extensive sloughing followed upon the dorsum of the foot, and our poor patient was greatly exhausted from the amount of the discharge, and the continued pain and want of rest, whilst it became evident that the knee-joint had become much worse since the occurrence of the erysipelas, the bones being rough and the articulation destroyed. Under these circumstances, it became a question whether amputation should not be employed to give the poor fellow a last chance of his life.

Mr. Pritchard was called in consultation, and met me on October 29, when it was decided that as soon as he could be prevailed upon to allow it to be performed, and could be prepared for the operation by the free exhibition of nourishing diet, and plenty of support and generous wine, that he should be removed to the Infirmary for that purpose as soon as ever he was able to undertake the removal to that establishment.

About a month elapsed ere this could be accomplished, during which time the active process of inflammatory mischief gradually lessened, and the system even showed some attempt to repair the mischief by cicatrising the wound upon the foot, by which, although at one time skin to the extent of many square inches had been lost by sloughing, yet, before he left home, the whole of this had been repaired, and the wound had quite healed.

On November 26, the man was carefully lowered from his bed-room window by means of a stretcher sliding

down an inclined plane, and from thence he was carried to the Infirmary by bearers, who carefully avoided giving him the least shock during the journey.

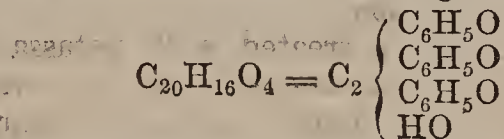
From this time forth the case was under the excellent care of Mr Pritchard, who kindly took charge of him at that institution, and removed his leg after a delay of five or six weeks, which was indispensable in order to re-establish his health somewhat more to enable him to go through the operation with success, which was finally accomplished, and about two months ago I heard that he had left the Infirmary, but was at that time unable to wear a wooden leg, as the wound was not quite healed.

Note on the Probable Constitution of Kolbe and Schmitt's Colouring Matter obtained by acting upon Carbohic Acid with Oxalic and Sulphuric Acids, by J. ALFRED WANKLYN.

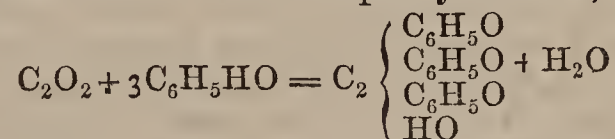
THE production of a colouring matter by the action of oxalic acid upon phenyl-alcohol in presence of sulphuric acid is a very remarkable thing. As yet no attempt has been made to give any explanation of the changes which take place during this process, and yet considerable quantities of a dye stuff are now being made in France in this manner.

The following hypothesis may be offered to connect together the facts as they are at present known.

Kolbe and Schmitt give C_5H_4O as the result of their analysis, state of condensation being unknown.



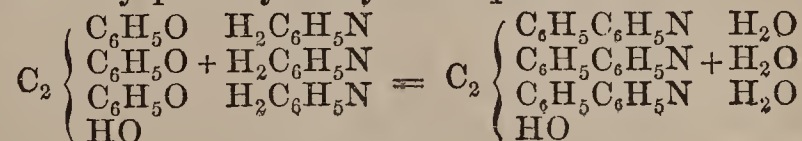
The probable reaction in Kolbe and Schmitt's process is between carbonic oxide and phenyl-alcohol, thus:—



The colouring matter is thus an "ethylene." Kolbe and Schmitt have observed that it is decolorised by means of nascent hydrogen. Explanation: The ethylene becomes a hydride of ethyl.

As might have been expected, it is a weak acid.

The obtaining of a blue dye from it by the action of aniline may possibly be by this equation:—



On the Rate of Chemical Change, by A. VERNON HARCOURT, M.A.*

Two years ago, at the Cambridge meeting of the Association, I communicated to this section a paper on certain cases of induced chemical action. In following up the course of experiments upon which I had then entered I became engaged in the study of various chemical changes which take place more or less slowly, and have thus been led into an inquiry as to the rate at which those changes proceed. Perhaps I may be allowed briefly to indicate the course of my investigation, for I shall thus more readily render intelligible the object of the later experiments. The principal case of induced oxidation, which I before described, was that which occurs when permanganate of potassium is added to a

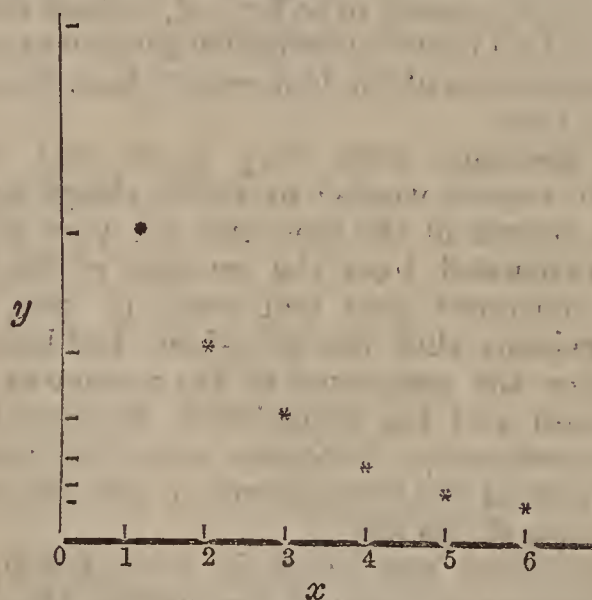
* Read before the British Association Bath meeting, and communicated by the author.

solution containing chloride of tin and oxygen. Under these circumstances, while a portion of the tin salt is oxidised by the permanganate, another portion is attacked by the free oxygen. A large number of similar cases have since been investigated by Kessler. My principal object was to determine what ratio existed between the two oxidations, and in scrutinising the conditions of the experiment it occurred to me to try whether the sulphate of manganese, formed by the reduction of the permanganate in the acid solution, had any influence. I found, greatly to my surprise, that this fixed neutral salt has itself the power of determining the transference of oxygen. Sulphurous acid, as is well known, when mixed with a large bulk of water which has been exposed to the air, is but slowly oxidised, and this change proceeds still more slowly when the solution is freely acidified. But if to such a solution a minute quantity of sulphate of manganese is added, the oxidation of the sulphurous acid is at once determined. It is like, so far as the result is concerned, the effect of adding a drop of sulphuric acid to a mixture of chlorate of potash and sugar. Sulphate of manganese has also the power of determining the action of various oxidising agents, as well as that of free oxygen. Professor Kessler observes that the cause of a phenomenon known to all chemists who have titred a chameleon solution with oxalic acid—namely, that the colour of the portion of solution first added disappears very slowly, but that of succeeding portions more rapidly—is that the sulphate of manganese, formed by the reduction of the first portion, hastens the subsequent action. Chromic acid has apparently no action upon oxalic acid in a cold dilute solution. The addition to this mixture of pure sulphate of manganese determines, under proper conditions, an immediate reduction of the chromic acid. How the sulphate of manganese acts in these cases is, at present, matter for conjecture. We may compare the action of this salt in determining the union of sulphurous acid and oxygen with that of nitric oxide. Perhaps in this case, as in that, an alternate oxidation and reduction takes place. If we may suppose that water can act to a small extent upon a manganese salt as it acts upon a bismuth salt, separate that is the base from the acid, then no doubt the hydrate of manganese thus displaced would absorb free oxygen, and the sulphurous acid at once reduce again the binoxide formed. At any rate, without insisting on so definite a hypothesis, it is probable that this action of the manganese salt is in some way related to the fact that the proto-hydrate of this metal has the property of absorbing oxygen from water, and parting with this oxygen to sulphurous acid. Similarly this proto-hydrate is readily oxidised by chromic or permanganic acid, and the resulting binoxide is readily reduced by oxalic acid.

Of these actions I have selected for study that of permanganic upon oxalic acid.

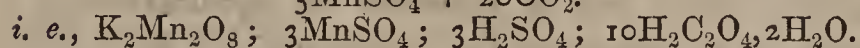
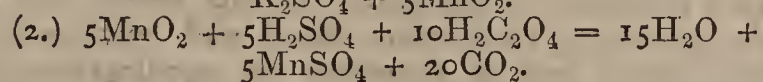
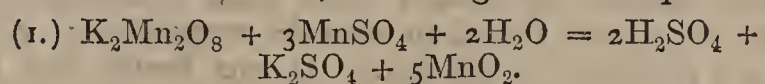
When the four following substances, permanganate of potassium, sulphuric acid, oxalic acid, and sulphate of manganese, are brought together in aqueous solution, a chemical change takes place, resulting in the formation of sulphate of potassium, sulphate of manganese, carbonic acid, and water. The amount of change depends upon the amount of each of the first-named four substances, upon the dilution and temperature of the solution, and upon the time during which the substances are left in contact. As far as can be observed, these are *all* the conditions which affect the amount of chemical change in this case; it is not affected by light, nor by the agitation of the solution. The amount of change is

greater, within certain limits, in proportion as the quantities of permanganate of potassium, sulphuric acid, and sulphate of manganese are greater, and the quantity of water less; in proportion also as the temperature is higher, and the time of mutual contact longer. It is greater, the larger the quantity of oxalic acid, up to that point at which the oxalic and permanganic acids are present in the proportions in which they act one upon the other; after that point, an increase in the quantity of oxalic acid diminishes the amount of chemical change. I have made many series of experiments, in each of which all of these conditions, except one, were kept invariable, and that one was varied according to a regular progression. I hoped thus, and still hope, to determine what function of each of these variable quantities the chemical change is, and so to obtain a true expression of the reaction. I made, for example, a series of experiments, in all of which I took the same quantities of permanganic acid, oxalic acid, sulphate of manganese, and water, maintaining always a temperature of 16° C., and allowing each experiment to proceed for exactly five minutes; but in the second experiment I took twice the quantity of sulphuric acid used in the first, thrice the quantity in the third, four times the quantity in the fourth, and so on. When five minutes from the moment of mixing had expired, the action was stopped, and the amount of permanganate still remaining determined. A series of numbers was thus obtained, presenting a regular decrease, which should bear an ascertainable relation to the corresponding quantities of sulphuric acid, taken, as has been stated, in arithmetical progression. This relation, however, I have not yet succeeded in determining, but in this, as in other series, the numbers exhibit the most perfect regularity. This is best seen by exhibiting the results graphically. Along the axis of x is represented



that quantity, which is varied in each successive experiment; along that of y the quantity of changing substance which remains still unchanged at the close of the experiment. This quantity, it will be seen, varies rapidly at first, the differences becoming less and less as the total quantity of residual substance diminishes. The series of experiments which appeared most interesting was that in which, all other conditions being kept constant, the time during which the experiment lasted was varied. Such a series yields a curve similar to that which represents the effect of varying the amount of sulphuric acid. The curve above serves, therefore, as a general representation of such a series. It may be regarded in this case as exhibiting the course of a single experiment, showing exactly how much of the substance measured remains after the lapse of any interval. The

numbers 1, 2, 3, &c., here represent the number of minutes during which the corresponding experiment was allowed to proceed. The mode of conducting an experiment was briefly as follows:—The solution containing all the substances except the permanganate was brought to the required temperature, and the permanganate added from a pipette exactly at the beat of a seconds' pendulum. When the time had expired, the temperature of the solution having been kept rigidly constant throughout, a solution of iodide of potassium was added again at the beat of the clock. During and after both additions the liquid was strongly agitated to secure rapid and perfect mixture. The addition of iodide of potassium stops the action. The remaining permanganate is at once reduced, and liberates thereby an equivalent of iodine which can be determined at leisure in the usual way. Of such series of experiments I have made a great number. In the first instance I took the exact quantities of the different substances which react one with another, according to these equations:—



But I was led to abandon atomic quantities principally by two considerations: first, any error in the proportion of the substances becomes magnified as the experiment proceeds; secondly, the solution changes, not in one particular only, but in several. The quantities of sulphuric acid, oxalic acid, and permanganate diminish, the quantity of sulphate of manganese increases, while that of the water alone remains sensibly constant. In later experiments I have taken all the other substances in such excess, as compared with the permanganate, as to be practically, like the water, infinite in relation to it. Of all, I have taken 100 times the atomic proportion, so that the total change taking place in the solution from end to end of the reaction would be a diminution in the amount of oxalic acid, and sulphuric acid from 100 to 99 parts, and an increase of 1 per cent. in the amount of sulphate of manganese. I found by an experiment in which the quantities at starting were varied 1 per cent., that such an alteration did not perceptibly affect the result. Under these conditions, then, one chemical substance gradually disappears, all around it remaining unchanged. A known quantity is introduced into the solution, which has from the first, where the oxalic acid and sulphate of manganese are in large excess, not a red, but a deep brown colour; the substance thus formed, and whose gradual disappearance we desire to trace, is in all probability binoxide of manganese. Having made a number of determinations after the lapse of various times we can follow exactly the course of its diminution. At first the colour changes rapidly, but as it becomes paler it fades more and more slowly. The axis of x is, no doubt, an asymptote of the curve; theoretically the whole would never disappear. The problem, then, to be determined was to find the relation between these two series of numbers—or, in other words, given this curve to find its equation. Into the details of this investigation I will not enter. Both it and a large number of the experiments already described have been performed by my friend, Mr. Esson, Fellow of Merton College, Oxford, who has charged me with the office of bringing before the Section some account of our joint work. The result at which we believe ourselves to have arrived is, that the numbers representing the quantities remaining after equal intervals of time, are in geometrical progression, and the curve conse-

quently a logarithmic curve. This result admits of a simple and interesting interpretation. It is precisely that which would follow from the hypothesis that the dissolved binoxide exists in the fluid in the form of minute spheres upon whose unit of surface is performed a constant action. The total action thus at any moment varies with the surface exposed, and diminishes continually as the spheres, shell after shell, melt away. But the result may be explained without the introduction of an hypothesis. If we suppose the binoxide of manganese to be replaced as it disappears, so that the quantity present is always the same, chemical change will proceed, since no condition alters, at a uniform rate, a certain fraction of the whole amount disappearing in a unit of time. But since the relation between the binoxide and the solution in which it is, is not affected by a change in the quantity of the former, one of these magnitudes being infinite relatively to the other, this fraction will remain always constant when the binoxide is not replaced, but is allowed to diminish; that is to say, the amount which changes during a moment of time is directly proportional to the total amount existing in solution at that time; or, if we regard the binoxide as doing work—oxidising oxalic acid—then the statement is that the amount of work done is directly proportional to the amount of substance which at any time is there to do it. It will be of interest to examine by similar methods other cases of chemical change in solutions. If it is found, as appears highly probable, that wherever the rate of change is measurable,—wherever, that is, it proceeds slowly, and can be started and terminated at a given moment, and the amount changed or remaining unchanged determined,—it follows the same law, then we may pass inductively to a generalisation covering those cases of chemical change which take place with an immeasurable velocity, or which cannot be arrested at will, or for the determination of whose residues or products no exact methods are known. Just as by the use of the pendulum or of Attwood's machine we may prove experimentally the laws of falling bodies, when in the common case of bodies falling freely the velocity with which they move is too great for measurement.

On the Solubility of Gold in Acids,
by JOHN SPILLER, F.C.S.

THE interesting discovery which my friend Mr. Arthur Reynolds, B.Sc., communicated to you in his letters of July 23 and October 1, has been made the subject of experiment on the part of myself and colleagues, and not only do we find Mr. Reynolds' conclusions in every way confirmed by our own experience, but the conditions involved in these remarkable reactions have, we trust, received some further elaboration by the experimental results which I now proceed to describe:—

Native gold, and more quickly the precipitated form of the same metal, are soluble on digestion with hot concentrated sulphuric acid mixed with a little nitric, with production of a yellow solution, which on being diluted with water lets fall a precipitate of gold, the colour of which is either bluish purple or bronze brown, accordingly as it is viewed by transmitted or reflected light. The tint is, however, subject to variation by the presence of extraneous salts, which have the effect of modifying the cohesion of the particles in a manner similar to that pointed out in the case of another kind of reduced gold by Professor Faraday.

If a small quantity of the yellow gold solution be poured into a porcelain capsule and left exposed to the

air, a purple halo and lustrous metallic film of reduced gold will quickly be formed by the operation of the atmospheric moisture. On applying heat this effect will be counteracted, but it is difficult in a shallow open vessel to form again the yellow solution. The experiment succeeds, however, perfectly when a test tube is employed.

The character of the gold compound existing in the yellow solution is manifestly different from the terchloride and other ordinary combinations of this metal. It becomes transformed at once into the chloride of gold by the addition of hydrochloric acid, sal ammoniac, or any soluble chloride such as that of sodium, calcium, or barium, and the solution may then be diluted with water without any of the gold being precipitated. As would have been anticipated, the addition of a small quantity of common salt will slowly re-dissolve the purple deposit formed on diluting the new gold solution.

I have succeeded in rapidly producing this interesting combination of gold by arranging a plate of this metal as the positive terminal of a few cells of Grove's battery, whilst immersed in a mixture of about nine parts of sulphuric acid to one of concentrated nitric acid, and employing a piece of platinum foil or wire-gauze as the opposite pole or terminal in connexion with the zinc of the battery. Oxygen gas was freely evolved, but almost immediately the yellow colour due to the presence of gold in solution became apparent, and the passage of the electric current was continued until bright gold commenced to be deposited upon the platinum terminal, from which throughout my experiment no hydrogen gas was disengaged.

If concentrated sulphuric acid be used alone in the electrolytic cell the gold plate will likewise be attacked, but the metal is at once reduced by the nascent hydrogen which freely escapes from the platinum; so that it does not appear to be possible to prepare the new gold compound in this manner. By the use of diluted sulphuric acid there was no solvent action exerted upon the gold, but the surface of the metal soon became tarnished or iridescent by the formation of a thin and strongly adherent film of brown oxide. This result appears to have been already observed by Professor Bunsen when employing for the electro-decomposition of water (mixed as usual with sulphuric acid) an apparatus in which the platinum terminals chanced to be attached to their connexions by means of gold solder.

Further researches are required for the purpose of indicating the exact constitution of the gold compound which forms the subject of the present communication. It does not appear to be identical with the solution of gold described under the name of "sulphate of auric oxide" by Pelletier (*vide* Gmelin's "Handbook of Chemistry," vol. vi., p. 211), inasmuch as it cannot be asserted with respect to the soluble combination discovered by Mr. Reynolds, that "when gently heated it deposits metallic gold."

Chemical Department, Royal Arsenal, Woolwich, October 3.

How Sparrows Found their Way into Cuba.—

In an article on "Acclimatisation" in the *Journal of Science*, by Dr. Collingwood, the author says:—"In 1830 a merchant wishing to import sparrows to the Havanna, found on arrival that the customs duties were so heavy that he could not hope to sell the birds profitably; he, therefore, let them fly—the birds entered the island free of duty, and at the end of some years their number was so much increased that in certain localities they are as numerous as they are at home."

PHARMACY, TOXICOLOGY, &c.

The Morphia Salts of Commerce,
by Mr. W. E. HEATHFIELD.*

THE inquiries of the author had been directed to the amount of moisture existing in these salts, and also to the question as to whether codeia was present in them.

Three samples of hydrochlorate from different manufacturers had been examined, and found to contain, respectively, 5.8 and 9.8 per cent. of water, estimated by drying at 212°. The amount of alkaloid obtained from each of the above (dried at 212°) was 79.7, 76.7, and 74.3, the quantities thus varying inversely as the amount of water.

It was noticed that the samples containing the most moisture dissolved more readily in water, and their solution were less coloured than those which were originally drier.

Three samples of acetate were then examined in a similar way, and found to contain respectively 5, 10, and 12.6 per cent. of moisture. It was found that the sample containing least water fused and became dark-coloured, with loss of structure on application of a water bath heat, while that containing the most water retained its pulverulent form unaltered at that temperature.

The morphia precipitated from these samples was found to be remarkably pure, being perfectly soluble in caustic potash, scarcely acted on by ether, and almost entirely free from codeia, as were also the mother liquors from which they were separated.

The author also quoted experiments by Mr. How to show that, however feasible the conversion of morphia into codeia might appear on a comparison of their formulæ, it could not be carried out; a substance isomeric with codeia had been obtained, but it was by no means identical.

On Commercial Wine of Iron, with Suggestions, by F. SUTTON, F.C.S.*

STEEL wine is well known to vary much in strength. The author obtained seven samples from the leading pharmaceutical chemists in London, and estimated the per-centage quantity of iron in them, and also the amount of saccharine residue they yielded on evaporation to dryness. The following table exhibits the results of the experiment:—

	Saccharine residue, per oz.	Metallic iron, per oz.
1 . . .	23 $\frac{3}{4}$ grains.	0.31 grains.
2 . . .	24 $\frac{1}{2}$ "	0.35 "
3 . . .	14 $\frac{1}{4}$ "	0.70 "
4 . . .	21 "	0.51 "
5 . . .	51 $\frac{1}{4}$ "	1.76 "
6 . . .	17 "	1.08 "
7 . . .	28 $\frac{1}{4}$ "	0.43 "

No. 5 was made with tartarated iron. The composition of the rest shows that the less saccharine residue a specimen of sherry yields on being evaporated to dryness, the more iron it is capable of dissolving. The metal should be digested in light sound sherry for four months to obtain the best preparation.

The examination of a number of samples made with tartarated iron showed that they contained about one instead of one and three-quarter grains of iron, the rest having precipitated. The author thought that if a strong

* Read at the meeting of the British Pharmaceutical Conference.

sound sherry were used, and the ingredients allowed to remain in contact for one month, access of air to the vessel being occasionally allowed, a satisfactory preparation could be made by the process.

On the Assay of the Alkaloids in Medicinal Extracts,
by T. B. GROVES, F.C.S.*

THE object of the author was to devise a process for estimating the strength of the vegetable extracts used in medicine. The method he employed was a volumetric one. Mayer, of New York, and Valser, of Paris, had worked upon the same subject, and all three had fixed upon the same liquid for precipitating the alkaloid, namely, the iodohydrargyrate of potassium. All three also had suggested formulæ for the precipitate. Valser's experiments corroborated those of the author, while Mayer's pointed to a different conclusion. Mayer's experiments were then reviewed, and the details of some reactions given, from which it seems that, on adding the iodohydrargyrate to the solution of the alkaloid, a point was arrived at—the addition of either liquid caused a precipitate. In this way some of the apparent anomalies might be explained. If, however, time were allowed for the completion of the reaction, more definite results might be obtained. He described the reactions with strychnia, quinine, cinchonine, morphia, nicotina, and codeia, and reviewed Mayer's results, which were quite, he said, anomalous. In estimating the amount of alkaloid in an extract, the alkaloid must first be isolated as far as possible by Stas's well-known method. In estimating the medicinal value of an extract, more exact methods than those now known must be discovered before accuracy can be attained.

A Report as to the Purity of Commercial Powders of Ipecacuanha, Jalap, and Opium, by F. M. RIMMINGTON.*

THE indications relied on were principally microscopic, to which was added estimation of amount of ash, not assuming that variation in the latter particular would be proof of adulteration, but considering that such a series of estimations would be collaterally interesting. Eleven samples of ipecacuanha from different localities were examined; all appeared to be genuine, and the amount of ash was tolerably constant, ranging from 2.5 to 3.7 per cent., except in one case, where 7 per cent. was found. Nine samples of jalap had also been examined; seven of them appeared genuine, the amount of ash ranging from 5.5 to 6 per cent., while two contained an abnormal amount of woody fibre, and in these the ash was reduced to 3.5 and 4 per cent. respectively. Of eight samples of powdered opium, six were found to contain varying quantities of starch. The per centage of ash was pretty constant, from 5 to 6.5, the variations being independent of the presence of the starch. The author regards the starch as an impurity in the opium as imported, having met with it in this form.

Preparation of an Artificial Marble.—By heating aragonite in a carefully luted iron crucible, as well as lithographic stone, and chalk in a porcelain vessel stopped with emery, the authors have obtained a true marble. That obtained with aragonite especially resembles Carrara marble.—*Moniteur Scientifique*, vi., 667, 64.

* Read at the meetings of the Pharmaceutical Conference.

PHYSICAL SCIENCE.

*Mr. Rodwell's Experiments on the Trompe.**

THE trompe is a species of blowing machine, which is used in mountainous countries for producing a blast for smelting operations. As now constructed it consists of a large cistern, from the bottom of which proceed two vertical tubes about twenty feet long; the lower ends of the tubes pass into a wooden wind chest, furnished with a blast-pipe for the exit of air, and also with an arrangement for keeping water within it at a constant level. Immediately below the point where the tubes enter the water cistern each tube is constricted, and a few inches beneath the constriction several holes are bored in the circumference of the tubes, so that air may have free access to their interior. When water is allowed to fall from the water cistern through the tubes, a quantity of air is carried down by the descending stream, which air separates from the water, as soon as it has entered the cistern, and rushes from the blast-pipe in a continuous current.

In the *Philosophical Magazine* for last month, Mr. Rodwell has detailed a number of experiments which he made in order to determine "the most favourable conditions under which air is carried down by a stream of water, and to arrive at a satisfactory explanation of the cause of the descent of air in the different modifications of the trompe."

In regard to the etymology of the word, Grignon ("Memoires de Physique sur l'art de fabriquer le fer, d'en fondre et forger des Canons d'artillerie, &c.") states that the trompe received its name from the fancied resemblance to a waterspout. Landais derives trompe (of which trompe is the old French form) from *στρόμβος*, a top, a spindle, a round shell, which in its turn is derived from *στρέφω*, to turn, twist, revolve. The author conceives that the trompe received the same name as a waterspout "either because of the mixed column of air and water produced in certain forms of the machine, or more probably from the whirling motion of the water around a conical cavity," which would occur in many of the old forms of the trompe; in both these respects there is a resemblance to a waterspout.

The second section of the paper is devoted to the description of an instrument by means of which the amount of air carried down by a stream under various conditions can be determined with accuracy. Several tables of experiments made with this instrument are given, which show the amount of air carried down by half a litre of water, under various conditions of pressure, velocity, &c., and flowing from (a) a circular, (b) rectangular, (c) square, (d) and triangular discharge tube. The constituent of a jet of liquid moving downwards with great velocity is considered, and it is stated that when such a stream falls through a vertical tube the area of the cross section of which does not exceed a certain dimension in relation to that of the orifice from which the liquid flows, discs of water are produced in the tube, which are pushed down by the descending stream, and force down the air beneath them. If, on the other hand, the pressure on the lower orifice of the vertical tube is competent to support a column of water at a certain height in the tube, the descending stream comes into direct collision with the water, and air is then carried beneath the water surface on account of the formation (by the descending masses of water) of cavities,

* "On Some Effects produced by a Fluid in Motion." No. II. On the Trompe.—*Phil. Mag.* for September, 1864.

into which air enters, according to the theory of Professor Magnus, of Berlin.

The author gives the following example to illustrate this mode by which air is carried beneath the surface of a liquid:—"We have a frequent example of this action of detached fluid masses. If we wish to pour out beer so that it shall have no froth we pour it down the side of the glass, the adhesion of which flattens the stream into a ribbon, and it enters the fluid in the glass slowly. There is no falling of detached masses here, consequently no air is carried down. On the other hand, if we wish to produce froth, we pour out the beer from as great a height as possible, and the masses detached by the accelerating force of gravity carve out channels in the liquid, into which air enters and is carried down, and afterwards rises to the surface in bubbles."

A small lead shot, weighing .072 gramme, was found to cause 192 times its own volume of air to penetrate beneath the surface of water by being thrown into it for a height of $1\frac{1}{2}$ feet at an angle of 60 degrees.

The greatest amount of air which the author found to be carried down by a stream of water flowing from a delivery tube $\frac{3}{10}$ ths of an inch diameter through a vertical tube $\frac{21}{60}$ ths of an inch diameter at the rate of half a litre in 24 seconds was, (a) by disc action, 615 c.c.; (b) by direct collision, 182 c.c. per half litre of water.

We have all noticed the whirling conical cavity which forms over an orifice in the bottom of a vessel from which a liquid is escaping. If rotatory motion is given to the liquid before it commences to flow, the cavity forms at a considerable height about the orifice, and air enters through it and makes its way into the issuing stream. This is discussed in the third section of the paper. The author found more air to be carried down by this means than by any other. Water flowing from a tube $\frac{13}{120}$ ths of an inch diameter, at the rate of half a litre in 39 seconds, carried down no less than 1392 c.c. of air for each half litre of water. "Stated in other words, a little stream of water about $\frac{1}{10}$ th of an inch in diameter at the orifice from which it issues, with a head of water of two feet, carries down in one hour 128 litres of air."

Let us suppose a continuous vertical tube less than 33 feet long in connexion with a water cistern, and moreover that water is flowing through the tube into a vessel containing water; if we close the orifice in the cistern from which the water issues a column of water will remain suspended in the vertical tube by atmospheric pressure. Now let an orifice be made anywhere in the circumference of the tube, and the column of water beneath that orifice will immediately fall, because the atmospheric pressure below the orifice is at once neutralised, and the water descends by its own weight. If we again cause water to flow through the tube, the column below the lateral orifice will obviously have greater velocity than that above it, hence rupture will ensue at the orifice, and air will enter, the flowing water will momentarily close the orifice, air will again enter, and so on.

The fourth section of the paper is devoted to the carrying down of air by this mode, and the author found that half a litre of water flowing from a delivery tube $\frac{3}{10}$ ths of an inch diameter carried down 320 c.c. of air.

In the fifth section Mr. Rodwell gives a summary of the investigation; this we give verbatim:—

"We see from the above that there are four modes by which air can be carried down by a stream of water falling through a tube.

"1. If the area of the cross section of the tube

through the water-falls be not much greater than that of the orifice from which the water flows, discs will be formed in the tube, and being pushed down by the descending stream, will force down the air beneath them.

"2. If the area of the cross section of the tube through which the water falls be much greater than that of the orifice from which the water flows, so that disc action is prevented; or if the pressure on the lower end of the tube be competent to support a column of water in the tube at such a distance from the orifice from which the water flows that the descending stream has not widened sufficiently to allow of the formation of discs, air will be carried beneath the water surface on account of the formation of cavities, according to the theory of Magnus.

"3. If there is not a great depth of water in the vessel which supplies the descending stream, or if (the depth not of necessity being small) rotatory motion is from any cause imparted to the water, air will enter through a cavity formed above the orifice from which the descending stream issues, and extending into the descending stream.

"4. If the area of the cross section of the orifice from which the water flows be as great, or nearly as great, as that of the tube through which the water falls, and if, at the same time, the orifices for the admission of air do not exceed a certain area compared with that of the orifice from which the water flows, air will enter at the rupture of the stream, produced at the orifices, by the accelerated motion of the water below those orifices.

"The cause of the descent of air in the different modifications of the trompe is not due to any one action of a stream of water; air is carried down by all four of the modes of action mentioned above.

"Generally only one mode obtains in one form of the machine; but there may be two modes acting simultaneously, the particular mode or modes being determined (a) by the relation of the area of the cross section of the trompe tube to that of the orifice from which the stream flows; (b) by the head of water above the orifice from which the stream flows; (c) by the fact of whether there are causes which induce rotatory motion in the water before it leaves the cistern; (d) by the form of the orifice from which the stream flows; (e) by the manner in which air is allowed access to the interior of the tube; and lastly (f) by the amount of pressure on the lower orifice of the tube.

"The first and fourth modes least seldom obtain; the second obtains in the generality of modern trompes; and the third obtains in the trompe described by Francois, in trompes with very shallow cisterns, in trompes in which the water before leaving the cistern receives rotatory motion, either from the stream which supplies the cistern entering at an angle to the water surface, or from some other cause, and in all trompes with inclined tubes (of which, as stated above, Kircher had seen forty prior to the year 1655).

"I consider the most economical, and in every way the most efficient form of trompe, to be the old form, in which there are no air holes, and the air enters by a conical cavity in the water above the orifice from which the descending stream issues. It will be seen from the above that by this method we obtain nearly double the amount of air obtainable by other means. The construction of such a trompe, moreover, is comparatively easy; there is no need to have the tubes perfectly vertical, and less spray is carried into the furnace than by the form of trompe now in use."

PROCEEDINGS OF SOCIETIES.

BRITISH PHARMACEUTICAL CONFERENCE.

THE following is a portion of the opening address of the President, Mr. Deane. After some remarks on the history and objects of the Conference, and some allusion to the publication of the British Pharmacopœia, the speaker proceeded to a topic which is now absorbing a good deal of attention. From this part of the address we shall make several extracts:—

“The next subject I have to refer to is one the importance of which to us, as responsible persons in the sale and dispensing of medicines, it is scarcely possible to over-estimate.

“The result of the trials on the late case, the acquittal of the assistant, who is supposed to have dispensed the medicine, from the charge of manslaughter, on the score of its being a pure misadventure, and the unavoidable compromise with the friends of the deceased, show that every one of us is standing on a mine which may at any moment explode, and send us to pecuniary perdition and despair. It matters nothing what amount of care and expense has been bestowed on arrangements to secure the public from accident; it matters not that the proprietor of an establishment is in no way to blame, or that the patient has died through a pure misadventure, the law requires that a jury shall award compensating damages to the injured family. We all know what that means to nineteen in twenty of those following the business—it means utter ruin.

“Allow me to state our case and position in society as an important branch of what is called a liberal profession. In the first place—

“All the responsibilities of professional men are laid upon chemists without either the dignity or emolument. We are treated as shopkeepers, with profits less than those of an ironmonger.

“Rich and poor of all grades do not hesitate to consult them in all sorts of difficulties, and obtain freely and gratuitously that for which a physician or consulting chemist would charge a handsome fee.

“That the information thus freely accorded to all is truly valuable is proved by the fact of the constancy of the practice, and the needless jealousy of many professional men.

“To obtain this amount of public confidence, a large expenditure of means, careful observation, energy, study, and integrity of purpose, are required.

“The more extensive the business of a chemist, the greater the responsibility; but not so the profits.

“When the public confidence is secured, it is the interest of the chemist to maintain it by all and every means in his power.

“Foremost amongst the means are the obtaining good assistants, and making such arrangements in the establishment as shall, as far as practicable, obviate all chances of accident, and ensure the detection of errors, and the sources of them. Having done this, and exercising constant watchfulness, all that a man can do has been done. Proof of successful care is shown in the small number of known errors made by dispensing chemists.

“Thus, a man may dispense 50 prescriptions daily, on an average of 300 days in a year, equal to 15,000 prescriptions, each of which will average 10 doses, or 150,000 doses annually! He goes on thus for many years, and never has the faintest trace of an accident arising from any fault or oversight of his own, and for which he rarely gets a fair share of credit. But during those years he has probably corrected numberless errors of prescribers, many of them of no trivial nature; but for this he has no credit, professional etiquette requires he should be silent. If the skill and foresight of the dispenser were

not habitually turned to such contingencies, serious accidents would frequently be recorded. Hence, the educated and careful dispenser, in the exercise of his skill, tact, and judgment, in avoiding the dangers incidental to his grave and responsible duties, is a benefactor to the community, and deserves better pay and higher consideration than the world is disposed to give. Yet a man, though gifted with clear intellect and sound discretion, and possessing a thorough knowledge of his business or profession, cannot after all claim exemption from that common imperfection of humanity—fallibility, and is not a bit less liable to error than the professedly more highly educated man who writes prescriptions, or the patient who carelessly takes up an opium liniment, and swallows it for a black draught, without exercising that common sense which we may safely state is the only true preventive of such accidents.

“No regulations could be devised nor Act of Parliament enforced to prevent a physician from making a wrong mark, which might lead to fatal results, nor prevent the recurrence of such facts as the following:—

“A lady of our acquaintance lately took into her hand an oval, fluted, half-pint bottle of chloride of zinc, having thereon a large red label, and ‘Poison,’ in large red letters, on the top of the bottle, and took a dose therefrom, instead of from a round pint bottle, having a small plain label, which she had used for two years for a soothing syrup in daily and frequent use.

“Another lady of our acquaintance went to a cupboard where medicines are kept on a middle shelf to procure a dose of fluid magnesia, but instead of taking the proper bottle standing before her face, got a chair and took a bottle of chloride of zinc from a distant corner of a top shelf, and, in spite of the red label and the word ‘Poison,’ took a dose, which killed her in a week.

“Such cases can be quoted by the dozen, together with numberless little inexplicable instances in daily life, of temporary absence of common sense, which serve to prove the frailty of human nature, and how powerless all rules and regulations must be to prevent their recurrence entirely.

“The case at Liverpool brings all these considerations before us in the most vivid manner. . . . Is a man to suffer destructive and ruinous spoilation because his assistant is not more than human? It is monstrous injustice. Who is safe amongst us if a ruinous prosecution is to follow an accident, however sad and fatal it may be, which may any day occur to any one of us,—a class of men proverbially and necessarily careful for their own existence’ sake? And who will enter a profession liable to such fatal responsibility?

“A general practitioner may, and does make numberless mistakes with impunity, because the facts are confined to himself and his own surgery. The eyes of the physician and the public are not on him or his dispenser, to stimulate to vigilance and care; thus few accidents under such circumstances ever see the light, and perhaps it is well it should be so. But cases do occasionally come before the public which contrast most favourably for the order and care exercised in every well-regulated pharmacy.

“The prosecutor in the Liverpool case was probably led away by the popular delusion that every chemist’s profits are enormously large, and that they must of necessity get rich out of the public,—not being aware that one-half of the chemists in the country do not, as a gross return, take 20s. per day, or 365l. per annum; and that the net profit earned by the other half little more than sufficed to keep soul and body together.

“Although it is now shown that the law makes the employer of an assistant responsible for the acts of the latter, I am at a loss to conceive on what principle of justice it is so, when it can be shown that no pains have been spared to prevent accidents. Without some change in the law, this must ultimately lead to the abandonment of the pro-

fession by educated and high-minded men, and their places taken by others, ignorant and reckless, and thus public safety will be jeopardised. The twelve pence now demanded for as many doses of pills, can only be adequately replaced by a sum equal to the fee of the prescriber, for it is clear we have the responsibility of two professions on our shoulders, which ought in common justice to be paid for.

"For some admirable remarks on this case, I may refer you to the *Liverpool Daily Post* of August 16 last, where you will find much that I have said, and a deal more, stated in the most lucid and forcible manner; and it will be seen how unjustly Lord Campbell's Act may be brought to bear upon a particular class of the community, and in cases where it could never have been intended it should take effect. I cannot refrain from quoting one passage, for reasons which I will not record here:—'Nay, more unlikely things have happened than for a man to commit suicide after surreptitiously mixing poison with a dose from a chemist, and so virtually bequeath to his family the damages obtainable by an action under Lord Campbell's Act. The deed is an unlikely one; but as the Insurance Companies deem it worth while to except suicide from the causes of death allowed by their policies, our supposition is not beyond the bounds of possibility.'"

ACADEMY OF SCIENCES.

September 26.

M. SCOUTETTEN contributed a memoir, entitled "*Researches on Mineral Waters, and specially on the Cause of their Active Properties.*" This cause, according to the author, is electricity. By coming in contact with electro-magnetic currents in the bosom of the earth, the waters undergo a sort of allotropic modification, which unfortunately does not last when the water comes to the surface, but is gone in three days at most. And now the mystery of mineral waters are unveiled, the author says the medical applications may for the future be made with exactness.

M. Renault presented another note "*On some Haloid Salts of Copper.*" In this paper the author describes the photographic properties of the iodide, bromide, and fluoride of copper. The bromide of copper is most sensible to light, and the picture may be fixed by employing the ordinary hyposulphite with care. Iodide of copper is less sensible to light, and the fluoride still less. We shall give this paper with the author's previous communication on the chloride of copper.

M. Hugo Schiff detailed some "*Researches on Complex Amides.*" This ingenious chemist has formed diallylidene-diphenamide, ænanthylidene-diethyl-diphenamide, toluene-diethyl-diphenamide, allylaniline, and ænanthylidene-diallyl-diphenamide.

NOTICES OF BOOKS.

Coffee and Chicory: their Culture, Chemical Composition, Preparation for Market, and Consumption; with simple Tests for Detecting Adulteration, and Practical Hints for the Producer and Consumer. By P. L. SIMMONDS. London: E. and F. N. Spon. 1864.

YEARS ago, the legend runs, a pious Mollah in Arabia, watching his goats, noticed that after browsing on the leaves and berries of a certain shrub, the kids seemed to experience an unwonted exhilaration of spirits, and skipped and danced about with more than usual agility. Struck by the fact, and stimulated, perhaps, by his forced abstinence from the only exhilarating fluid known in these days, the pious man determined to try the effects of the plant on himself; so he gathered the leaves and berries, and made a decoction, and became the first coffee drinker. The story probably is not true, and Mr. Simmonds does not notice it; but if not true, we may say it is *ben trovato*.

How men were first brought to roast the berries before they made the decoction is unknown. It may have been by some such accident as led to the method of roasting pig in China as described by Charles Lamb.

The stimulating effect of the decoction was probably the origin of the name bestowed upon the plant, which was kâhwâh, an old Arabic word for wine—a name which is retained in some form or other wherever the berry is used.

The name, or more likely the effect, of the beverage gave rise to a dispute among the Mohammedan doctors as to the legality of its use; but common sense prevailed, and coffee is drunk without concealment or qualms of conscience by the most rigid of Mussulmen.

The consumption of the berry is now enormous. Europe imports annually about 270,000,000 lbs., of which France consumes one-sixth. In 1862 the United Kingdom consumed 34,451,766 lbs., which, however, was one million and a-half pounds less than in the preceding year. The consumption thus averages a pound a-year for each individual of the population; but it is not equally distributed. The Scotch consume much less than the English, and the Irish much less than the Scotch.

The above figures represent the genuine berry, but not the amount of so-called coffee consumed by the population. Mr. Simmonds has a chapter on adulterations, from which we learn that almost everything which can be dried and ground, including the livers of oxen and horses, seems to find its way to the coffee-mill under the name of "Boston." After that, it is refreshing to read the story of a gentleman who visited a large American hospital, and noticed barrels of dried coffee grounds. Inquiring the use of these, a polite official informed him that they received twelve dollars a barrel for the grounds, which were to be "re-aromatised by the transforming hand of modern chemistry," and sold in pound papers with attractive labels and under high-sounding names.

It is not necessary to inform our readers how they may detect chicory, mahogany dust, and various starch granules, but they may wish to know how to recognise horse-liver coffee. "This adulterant," says Mr. Simmonds, "may be known by allowing the coffee to stand till cold, when a thick pellicle or skin will form on the top."

The chemical composition of the berry suggests more than a doubt of the propriety of roasting it for an article of diet. Our readers are familiar with the ingredients, but we will quote a part of Payen's analysis to support our assertion. According to this authority one hundred parts of coffee contain, among other things—

Casein	.	.	.	.	.	13.00
Sugar	.	.	.	.	.	6.50
Gum	.	.	.	.	.	9.00
Fat	.	.	.	.	.	12.00

Now, in the process of roasting, the sugar is, no doubt, converted into caramel, and thus one nutritive ingredient is disposed of. The remainder of the constituents noted above are most likely greatly modified or destroyed, especially in the more highly roasted berries, and all this destruction is effected to produce a small quantity of empyreumatic oil. We possess no analysis of roasted, but we have the assertion of Payen that slightly roasted coffee contains the maximum of nutrition, which, perhaps, comes near the truth.

How a decoction of the simply dried berries would taste we do not know, but it would probably be as agreeable as an infusion of tea, and certainly much more nutritious. The late Mr. Soyer, if we remember rightly, suggested that tea leaves should be slightly roasted to improve the flavour, and the process would not be at all more absurd than roasting coffee.

How to make coffee is a not unimportant chapter in Mr. Simmonds' book. The art may be said to be in its infancy in this country. Everywhere on the Continent, and generally abroad, good coffee is always to be had, while in this country our most expensive coffee-houses

supply very inferior, and in private houses it is, for the most part, detestable. Seeing that coffee is cheaper here than in most countries, this is absurd; and we may commend the instructions in this book to all who desire to improve the beverage.

Of chicory we need not speak—no one of good taste cares for it with coffee, and no one who has any regard for his bowels drinks it alone. It makes a dark decoction, which is slightly purgative, but is destitute of all the qualities which have made coffee an almost universal drink.

In conclusion, we may recommend Mr. Simmonds' book to all readers who wish to be well informed on the subjects of which it treats.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2050. John Joseph Parkes, Paddington, Middlesex, "Improvements in the application of gas and other fluids or liquids for lighting and other purposes, and in apparatus connected therewith."—Petition recorded August 18, 1864.

2157. William Lundi Duncan, Hunter Street, Brunswick Square, Middlesex, and Sidney Chilon Child, Clapham, Surrey, "Improvements in bleaching coloured and other rags or other materials or half-stuff, and in rag-engines for paper-making."—Petition recorded September 2, 1864.

2175. John Knowles Leather, St. Helens, Lancashire, "Improvements in the manufacture of salts of chromium from chrome ore."—A communication from Benedict Margulies, Trieste, Austria.

2181. William Henry Perkin, Sudbury, Middlesex, "Improvements in preparing colouring matters for dyeing and printing."—Petitions recorded September 6, 1864.

2223. Henry Craven Baildon, Edinburgh, "Improvements in the manufacture of inks or writing fluids to be used with certain kinds of paper for the prevention of fraudulent alterations in bankers' drafts, notes, cheques, and other documents in which it is important to avoid alteration or erasure."—Petition recorded September 12, 1864.

2244. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the preparation or treatment of colouring matters obtained from aniline." A communication from H. F. G. de Claubry, Paris, France.—Petition recorded September 14, 1864.

2267. John Barker Huntington, Furnival's Inn, London, "An improvement in the scales of aneroid barometers and of mercurial barometers."—Petition recorded September 16, 1864.

2279. David Hunter Brandon, Rue Gaillon, Paris, "Improvements in the treatment of tar oils for the purpose of employing the same as paint." A communication from Vincent Cordier, John Claudius Cordier, and John Gatliff, Paris, France.—Petition recorded September 17, 1864.

2313. Isham Baggs, Cambridge Terrace, Islington, Middlesex, and William Simpson, Maidstone, Kent, "Improvements in the manufacture of chlorine."

2317. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of sugar, and in apparatus employed therein." A communication from Adolphe Leqmine, Plaguy, France.—Petition recorded September 21, 1864.

Notices to Proceed.

1236. William Wilson, Manchester, Lancashire, "Improvements in and apparatus for generating gas from hydro-carbon or other volatile oils, for illuminating and other purposes."—Petition recorded May 17, 1864.

1254. John Bilby Merrikin, Bath, Somersetshire, "Improvements in bottles or vessels for containing poisons."—Petition recorded May 18, 1864.

1262. Thomas Dunlevie, Dublin, Ireland, and John Jones, Liverpool, Lancashire, "Improvements in metallic alloys."—Petition recorded May 19, 1864.

1285. Cowper Phipps Coles, Southsea, Hampshire, "Improvements in protecting the bottoms and sides of wooden and iron ships and other submerged structures."—Petition recorded May 21, 1864.

1296. Benjamin Jones, Warrington, Lancashire, "Improvements in the mode or method of obtaining sulphur from alkali or blue waste."—Petition recorded May 25, 1864.

1346. George Davies, Serle-street, Middlesex, "Improvements in artificial teeth, and in moulds for forming the same."—A communication from John Perrel and Joseph Stubb, Philadelphia, U.S.A.—Petition recorded May 31, 1864.

1759. Alexander Angus Croll, Coleman-street, London, "Improvements in the manufacture or preparation of material for the purification of gas."—Petition recorded July 14, 1864.

1842. David Barker, Battersea-park, Surrey, "Improvements in the manufacture of artificial fuel."—Petition recorded July 23, 1864.

2088. Arthur Auckland Leopold Pedro Cochrane, Portsmouth, Hampshire, "Improvements in apparatus for heating and evaporating liquids and fluids."—Petition recorded August 24, 1864.

CORRESPONDENCE.

Dr. Muspratt on the Buxton Thermal Spring.

To the Editor of the CHEMICAL NEWS.

SIR,—As so much has been said with regard to the Bath thermal water at the British Association, I think this a fitting opportunity to send you, for publication, my recent analysis of the Buxton water, which has, for many years, been so famous in the cure of rheumatism, gout, chlorosis, chronic skin diseases, &c., and which comes under the same category as the Bath and Bristol hot springs.

	Grains in the Imperial Gallon.
Carbonate of lime, CaOCO_2	... 8'541
Carbonate of magnesia, MgOCO_2	... 3'741
Carbonate of iron, FeOCO_2	... 0'082
Chloride of calcium, CaCl	... 1'227
Chloride of magnesium, MgCl	... 0'463
Chloride of sodium, NaCl	... 2'405
Chloride of potassium, KCl	... 0'260
Sulphate of lime, CaOSO_3	... 0'330
Silicic acid, SiO_2	... 1'044
Organic matter	... 0'341
Phosphate of lime and alumina, fluoride of calcium, nitric acid, &c.	... 1'076

19'510

The thermal springs at Buxton issue from fissures in the calcareous rock, and are attended by often repeated but suspended volumes of gas, which escape partly as large bubbles and partly in countless minute vesicles of water, giving to the liquid freshly collected in glass vessels all the appearance of aerated water. As it gurgles up, the water is clear, sparkling, and almost tasteless. The temperature is a little above 82° Fahr., and the specific gravity 1'000339. On evaporating four gallons of the water to dryness, at 212° , the residue obtained weighed 78'04 grains, equal per gallon 19'510 grains.

The most remarkable feature of the Buxton water is the very large quantity of nitrogen which it eviscerates.

	Cubic inches per gallon.
Nitrogen	... 204'00
Free carbonic acid	... 8'50

To what ingredient or ingredients does the Buxton water owe its efficacy? Calcareous waters, we know, are stimulant, alterative, and constipatory, but in what way they act beneficially in cases of gout, &c., remains to be proved. Some consider their curative power to be due to the nitrogen, but how can this be, when the water can only hold *in solution* the merest trace of this gas? The imbibition of the nitrogen seems to me to be a mere theoretical speculation, and has not the slightest foundation from experiment, the only true test for any one to raise deductions upon. Few subjects connected with medicine are more interesting than that of mineral water. The circumstances attending their direction or management, the natural mode of their production, the scenery in which they are often placed, combine to impart to them, as remedies, an interest exceeding that of ordinary agents for healing or for mitigating disease. My friend Playfair analysed the water of Buxton many years ago, and it is gratifying to find our results are so much alike. In concluding, I may state that the gases in these springs are closely allied to those of the thermal water at Bath, but whether "the singular chemical character of the Buxton tepid water must be ascribed to its gaseous and not to its solid ingredients" is, as Dr. Falconer writes, "a nut that will be cracked some day."

I am, &c.,

SHERIDAN MUSPRATT, M.D., &c.,

Professor of Chemistry.

College of Chemistry, Liverpool, September 27.

MISCELLANEOUS.

Messrs. Churchill's Literary Announcements.—

The publishing season may be said to open with the October session, and we have now before us the list of works now ready, or shortly to be issued by Messrs. Churchill. It includes new editions of Dr. Taylor's "Principles and Practice of Medical Jurisprudence;" Dr. Headland on the "Action of Medicines;" Galloway's "Manual of Qualitative Analysis;" Squire's "Companion to the British Pharmacopœia;" Royle's "Materia Medica," to be edited by Dr. Headland;" Waring's "Manual of Therapeutics;" the "Cyclopædia of Practical Receipts," by Messrs. Cooley and Brough;" and Beasley's "Book of Prescriptions." A new work, "Elements of Materia Medica," by Dr. W. Frazer, is announced as nearly ready.

Suggestions for the Custody and Sale of Poisons.

1. That none but qualified persons, educated to the trade of druggists, should be allowed to vend by retail drugs or medicines capable of acting as poisons.

2. That the sale of poisonous drugs by chandlers, grocers, oilmen, drapers, or small shopkeepers should be strictly prohibited. [A license might, if necessary, be granted, enabling these persons to sell certain specified medicines used by the poorer classes.]

3. That the sale of arsenic, strychnia, and other specified poisons should, after a certain date, be restricted to pharmaceutical chemists and licentiates of the Apothecaries' Society. Any other persons acting as druggists not to be permitted to sell them, until they have proved their knowledge of poisonous drugs by undergoing a proper examination.

4. Under no circumstances should boys or girls, or persons who cannot read or write, be permitted to sell poisonous drugs.

5. Some rules are required for the management of a licensed retail trade in poisonous drugs. No youth should be allowed to dispense or sell them who is not above the age of eighteen years, and who has not been for at least one year engaged in the practice of pharmacy, under a pharmaceutical chemist or licentiate of the Apothecaries' Society. This restriction not to be applied to one who has passed an examination either at the Pharmaceutical

Society or at Apothecaries' Hall, as to his knowledge of poisonous drugs.

6. That poisonous drugs and medicines having a similar colour and appearance should not be kept near to each other in similar bottles, drawers, or boxes with similar labels.

7. That less facility should be given for the purchase of arsenic, strychnia, and other deadly poisons, which can be used for the purpose of suicide or murder.

8. That no poisonous drugs should be sold to girls or boys under the age of twenty years, on any pretence whatever, and that in all cases of purchase there should be a witness of adult age.

9. All poisonous drugs sold should be distinctly labelled with the name of the drug, the address of the vendor, and the date of sale.

10. That noxious substances, such as arsenic, corrosive sublimate, sugar of lead, and tartar emetic, and others of the like nature, when stored in large quantities in casks or packages, should be distinctly labelled, and kept apart from other substances of an innocent kind which they resemble. [Many of the accidents which occur from carelessness in dispensing, and ignorance in administering, medicines, might be prevented by the adoption of Mr. Thonger's patent labels, which are provided with a sand-paper border.]—*Report of Medical Officer of Privy Council.*

Substitutes for Indian Ink.—A substance much of the same nature and applicable to the same purposes as Indian ink may be formed in the following manner:—Take of isinglass three ounces: make it into a size by dissolving over the fire in six ounces of soft water. Take then Spanish liquorice one ounce, dissolve it in two ounces of soft water over the fire in another vessel, then grind up on a slab with a heavy muller one ounce of ivory black with the Spanish liquorice mixture. Then add the same to the isinglass size while hot, and stir well together till thoroughly incorporated. Evaporate away the water, and then cast the remaining composition into a leaden mould slightly oiled, or make it up in any other convenient way. This composition will be found quite as good as the genuine article. The isinglass size mixed with the colours work well with the brush. The liquorice renders it easily dissolveable, on the rubbing up, with water, to which the isinglass alone would be somewhat reluctant; it also prevents it cracking and peeling off from the ground on which it is laid. A good Indian ink may be made from the fine soot from the flame of a lamp or candle received and collected by holding a plate over it. Mix this with the size of parchment, and it will be found to give a good deep colour. Burnt rice has been by some considered a principal ingredient in the genuine Indian ink, with the addition of perfumes or other substances not essential to its qualities as an ink.—*British Journal of Photography.*

ANSWERS TO CORRESPONDENTS.

* * All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements and Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

A. H. A.—Received. Answer next week.

J. Morgan.—There is a large sale for the article. We do not know the market price.

Received.—Dr. Machattie; A. R.

Books Received.—Watt's Dictionary of Chemistry, Part XX.; The Ophthalmic Review, No. 3; The Mining and Smelting Magazine for October; Storer's Dictionary of Solubilities, Part III., completing the work; Miller's Elements of Chemistry, Part II., Inorganic Chemistry

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Chemical Examination of a Hot Spring containing Cæsium and Lithium in Wheal Clifford, Cornwall, by W. A. MILLER, M.D., Treas. R.S., Prof. Chemistry King's Coll., London.**

IN the course of conversation with Sir C. Lyell a few months ago, he mentioned to me the existence of a remarkable hot spring in one of the Cornish mines, occurring at a great depth below the surface, and of which no detailed chemical examination had been published. The interest attending such an examination was obvious, and it was arranged that a supply of the water should be forwarded to me for analysis. Mr. Horton Davey, of Redruth, at the request of Sir C. Lyell, kindly superintended the collection of the water. Part of this water, which was to be examined for its gaseous constituents, was received into glass Winchester quart bottles, filled by immersion in the spring to within a very short distance of the neck, the stoppers inserted and securely fastened.

Wheal Clifford is a copper mine near Redruth, in Cornwall, situated some miles from the coast. The lode runs east and west in a fissure of the clay-slate, and consists of a porous copper pyrites; the spring comes up in the lode itself, one wall of which, where the spring breaks out, is formed by a dyke of elvan or granitic porphyry. This spring has been roughly estimated by Mr. Davey to yield 150 gallons a minute. It issues at a temperature observed by Professor W. Smyth of 122° or even of 125° , as stated by Mr. Davey from observation at a somewhat deeper point.† The temperature in that part of the mine from which the water was taken was 110° , the sample of water being collected in the 230 fathom level, or about 220 fathoms below the mean level of the sea.

The following are the results of the analysis:—

Specific gravity at 60° F.	1007.0
1 Imperial gallon contains of gases at 30 inches bar. and 60° F.	8.91
Consisting of	
Carbonic acid	1.89
Oxygen	1.72
Nitrogen	5.30
Ratio of oxygen to nitrogen.	1 : 3
1 Imperial gallon contains of fixed salts by evaporation	646.1
Consisting of	
Chloride of lithium	26.05
Chloride of potassium with a little chloride of cæsium.	14.84
Chloride of sodium	363.61
Chloride of magnesium	8.86
Chloride of calcium	216.17
Sulphate of calcium	12.27
Silica	3.65
Oxides of iron, manganese, and aluminum	traces
	645.45

The total saline contents was ascertained by evaporating a tenth of a gallon with carbonate of sodium. The determination of each constituent was effected in nearly every case upon 0.1 gallon of the water, and the

mean of two determinations was taken. The chlorine was ascertained by precipitation with fine silver, as in the ordinary method for humid assay. It was necessary to precipitate the magnesia in the form of hydrate by the addition of hydrate of baryta to the water after it had been concentrated by evaporation, in order to prevent the lithia from going down with it as phosphate, which occurred when it was attempted to separate the magnesia in the usual manner. The precipitated hydrate of magnesia was then redissolved in acid, and its amount determined as usual in the form of pyrophosphate.

The amount of lithium was ascertained by evaporating the filtrate from the hydrate of magnesia after the addition of hydrate of baryta, separating lime and excess of baryta by the addition of oxalate of ammonium, evaporating to dryness, and expelling the ammoniacal salts by a moderate but prolonged heat. The residue was moistened with hydrochloric acid, and again dried at about 350° F.

The lithium was then determined as phosphate by Mayer's plan as follows:—The alkaline chlorides were dissolved in a small quantity of water, mixed with a slight excess of rhombic phosphate of sodium, and evaporated slowly to dryness, maintaining a very feebly alkaline reaction by the addition of small quantities of a weak solution of hydrate of soda. The dry residue was then digested with a small quantity of water, to which an equal bulk of strong solution of ammonia was subsequently added, and the mixture allowed to stand for twelve hours. The crystalline precipitate of phosphate of lithium was collected on a small filter and washed with a rather strong solution of ammonia. 0.2 gallon of the original water gave 4.74 grains of the phosphate of lithium ($L_3P\Theta_4$).

This result was checked by determining the amount of sulphuric acid and potassium in a known weight of the mixed sulphates of sodium, potassium, and lithium. The result of this indirect method indicated 27.5 grains of chloride of lithium per gallon.

The occurrence of so large an amount of lithium, being eight or ten times as much per gallon as has been found in any spring hitherto analysed, invests this water with unusual interest and importance; and as lithium has been employed medicinally to an extent hitherto limited by its high price, it may prove of great commercial value. No less a quantity than 800 lbs. of the chloride of lithium would be furnished every twenty-four hours by this spring on the supposition that it contains 26 grains of the chloride per gallon, and yields 150 gallons per minute. The presence of cæsium in quantity by no means insignificant also adds to the importance of the spring, as no doubt the mother liquor might be employed as a source of cæsium after the separation of lithium.

The following is an outline of a process by which the salts of these two alkaline metals might be extracted:—

The water must first be raised without dilution to the surface. It must then be reduced by evaporation to about a twelfth of its bulk, or to a specific gravity of 1.080. As the water does not deposit any sensible amount of fur when boiled down, this preliminary concentration might be effected at little cost in the boiler of a steam-engine to save fuel.

To the concentrated and boiling liquid a strong solution of carbonate of sodium must next be added gradually so long as it produces a precipitate. A copious granular deposit, consisting chiefly of the carbonate of calcium, is thrown down, carrying with it a sensible amount of carbonate of lithium.

* Read at the meeting of the British Association at Bath, and communicated by the author.

† Professor Smyth communicated to the meeting at Bath some details respecting the geological features of this spring, to which for further particulars the reader is referred.—*Mining and Smelting Journal*, October, 1864, p. 193.

The clear liquid is decanted; it retains alkaline chlorides only. It must be rendered just acidulous to litmus by hydrochloric acid, and evaporated down; chloride of sodium will crystallise out; and on adding carbonate of sodium to the concentrated liquor impure carbonate of lithium will be deposited.

The mother liquors may then be treated for caesium. But as the amount of its salt is very small, compared with that of the other alkalies, no means appears at present to be applicable but that described by Bunsen and Kirchhoff (*Phil. Mag.*, November, 1861)—viz, the addition of perchloride of platinum, with a view to the formation of the sparingly soluble double salts of caesium and platinum ($2\text{CsCl}, \text{PtCl}_4$), and subsequent removal of the potassium compound, which goes down with the caesium salt, by repeated boilings with small quantities of water.

It was by following this method and examining the washed platinum salt in the spectroscope that caesium was ascertained to exist in this water. No evidence of the presence of rubidium was thus procured, though possibly, had I been able to operate on a still larger quantity of water, I might have been enabled to detect it.

On the Indirect Determination of Potash and Soda,
by P. COLLIER, B.A., Assistant in the Sheffield Laboratory, Yale College.

THE method customarily employed in estimating potash and soda—viz., by the precipitation of the former as platino-chloride of potassium, and reckoning soda from the loss—though sufficiently accurate in patient and skilful hands, is yet open to many sources of error, and at the best is exceedingly tedious and troublesome.

The indirect method does not yet appear to possess the confidence of chemists—at least, it is rarely mentioned in published investigations. I have, therefore, at the suggestion of Professor Johnson, made a number of experiments to ascertain the limits of error in this process.

The volumetric estimation of chlorine as perfected by Mohr offers by far the best basis for an indirect determination of the alkalies. It is, in fact, requisite, in employing the usual direct method, to procure the alkalies in the condition of pure chlorides before precipitation.

When the alkali chlorides are obtained free from all foreign matters, it is but the work of a few moments to ascertain their contents of chlorine.

The silver solution used for this purpose is best prepared by weighing off in a porcelain crucible about 4.8 gm. of clear crystallised nitrate of silver, fusing it at the lowest possible heat, and then ascertaining its weight accurately. After fusion it should weigh a little more than 4.7933 gm., the quantity that, contained in a litre of water, gives a solution of which 1 c. c. = .001 gm. of chlorine. The fused salt is dissolved in a little warm water, the solution brought into a litre flask and filled to the mark, observing the usual precautions as to temperature, &c. When thus adjusted, add to the contents of the flask, from a burette, enough water to bring the excess of nitrate of silver above 4.7933 gm. to the requisite dilution. In this way it is easy, with a burette and litre flask, to make a perfectly accurate standard solution, while this would be hardly possible should the operator weigh off less than 4.7933 gm. of nitrate of silver.

This solution, which may be preserved in a well-corked bottle indefinitely, without change, is next tested by means of a solution of pure chloride of sodium or

chloride of ammonium; a quantity, say about 2 grains, of one of these salts being dissolved in a litre of water and 10 c. c. of the liquid taken for the comparison. The solution being ready, the estimation of chlorine is conducted as described by Messrs. Mohr, Fresenius, Sutton, and others, chromate of potash being employed to indicate the completion of the reaction. The use of Edmann's float in a burette (which may hold 70 c. c.) graduated to fifths ensures the needful accuracy of reading. In my determinations $\frac{2}{10}$ ths c. c. of silver solution were deducted as the excess needed to produce a visible quantity of chromate of silver.

The appended table gives the results I obtained in analyses of the chlorides of potassium and sodium. The salts were perfectly pure, and the quantities were weighed out in each case. In order to test the method thoroughly, I have varied the proportions of the mixtures from one extreme to the other.

Summary of Volumetric Chlorine Determinations.

	KCl taken.	NaCl taken.	Cl found.	KCl calculated.	NaCl calculated.	Cl calculated.
1st analysis	.0582	..	.02780	.05725	.00095	.02768
2nd "	.1668	..	.07940	.16617	.00063	.07932
3rd "	.1507	..	.07168	.15056	.00014	.07167
4th "		.0590	.03600	..	.06062	.03579
5th "	.0782	.0317	.05640	.07831	.03159	.05642
6th "	.0305	.0379	.03750	.03044	.03796	.03750
7th "	.0455	.0169	.03290	.04464	.01776	.03189
8th "	.0166	.0480	.03720	.01514	.04946	.03701
9th "	.0530	.0429	.05120	.05319	.04271	.05123
10th "	.0431	.0820	.07027	.04282	.08228	.07024
11th "	.0992	.0182	.05820	.09929	.01811	.05821
12th "	.0967	.0102	.05217	.09669	.01021	.05217
13th "	.0101	.1029	.06718	.01039	.10260	.06722
14th "	.1284	.0067	.06512	.12841	.00669	.06512
15th "	.0065	.1100	.06990	.00584	.11066	.06982

It may be seen from the above list of analyses, which includes all the determinations I have made from first to last, for the purposes of this paper, that in no case does the difference between the quantities taken and found of either alkali chloride exceed two milligrammes, and in most instances it is less than one milligramme. The correspondence between the amounts of chlorine as taken and found, is, of course, still more near. The error that appears in the estimation of the chlorides would be considerably reduced, if, as usually happens, they were calculated as oxides.

Here follow the formulæ which I have employed for calculating the quantities of NaCl and KCl, or of NaO and KO, contained in or corresponding to any mixture of alkali chlorides whose total weight and amount of chlorine are known.

W = weight of mixed chloride.

C = weight of chlorine.

$\text{NaCl} = C + 7.6311 - W + 3.6288.$

$\text{KCl} = W + 4.6288 - C + 7.6311.$

$\text{NaO} = C + 4.0466 - W + 1.9243.$

$\text{KO} = W + 2.9243 - C + 4.8210.$

The results I have obtained thus demonstrate that the indirect method is in all cases equal in accuracy to the ordinary separation, while in the matter of convenience and economy of time there is no comparison between them.—*American Journal of Science*, vol. xxxvii., p. 344.

On the Determination of Nitrogen by Weight, by
WOLCOTT GIBBS, M.D., Rumford Professor in Harvard University.

BUNSEN* has given a method of analysing nitrates and nitrites which renders it possible to determine all the

* *Ann. der Chemie und Pharmacie*, lxxii, 40.

constituents of the salt in a single analysis. This method consists essentially in igniting the salt in an atmosphere of nitrogen gas, absorbing the oxygen evolved by metallic copper, and collecting the water in a chloride of calcium tube. The nitrogen in the salt is given by the loss of weight in the apparatus.

In those analyses of nitrates or nitrites in which it is only desired to determine the nitrogen, the following process may be employed with advantage:—

A hard glass tube about six inches in length is sealed at one end, and its volume determined by filling it with mercury and pouring this into a graduated vessel. The tube is to be carefully dried and weighed with a good cork; it is then to be filled with finely divided metallic copper, prepared by the reduction of the oxide, so as to enable the operator to judge of the quantity necessary. The salt to be analysed is then weighed and mixed with the metallic copper, either in a mortar or with a mixing wire in the tube, and the tube with its contents and cork is again weighed. The weight of the copper employed is thus known, and its volume may then be found by dividing this weight by the density of metallic copper. A weighed chloride of calcium tube is then adjusted as in organic analysis, and the combustion tube is heated in the usual manner. When the combustion is finished, the open end of the chloride of calcium tube is sealed with the blowpipe flame, and the combustion tube allowed to become perfectly cold. The chloride tube is then removed and weighed, and the combustion tube also weighed with its cork. The increasing weight of the chloride of calcium tube gives the amount of moisture in the copper and the water in the salt analysed. The loss of weight in the combustion tube gives the nitrogen in the salt after correction for the oxygen in the tube, for the moisture in the copper, and for the water in the salt. The correction for the oxygen in the combustion absorbed by the copper is easily found, with a sufficiently close approximation, by subtracting the volume of the copper from that of the tube, finding the weight of the residual air, taking one-fifth of this as oxygen, and considering the whole of this oxygen as absorbed by the copper. A piece of asbestos may be placed between the copper and the cork with advantage; but this renders an additional correction necessary.

Two analyses were executed by this method. In the first a sample of pure saltpetre gave 13.86 per cent. nitrogen; the formula KO, NO_3 requires 13.86 per cent. In the second, a specimen of the commercial salt gave 13.7 per cent. nitrogen, while the same salt analysed by Simpson's method, in which the volume of the nitrogen is determined, also gave 13.7 per cent. The whole analysis, with the weighings, may easily be executed in an hour and a half by a single person. It is easy to see that this method applies to all inorganic nitrates and nitrites, whether hydrous or anhydrous, but that it cannot be employed in the case of organic or ammoniacal salts. In the analysis of inorganic nitrates or nitrites by Simpson's method, it is not necessary to use oxide of mercury to prevent the formation of dinitrogen oxide. In all such cases it will be found sufficient to mix the salt with pure metallic copper. In this manner the dimensions of the combustion tube may be greatly diminished. I have also found it advantageous to pump out the air from the combustion tube by a small hand air-pump before disengaging carbonic acid from the carbonate of manganese. By alternately pumping and filling the tube with carbonic acid, the air may be completely expelled before the combustion commences. It is also better to draw the tube out before a Bunsen's gas-blast,

as it is difficult to make a cork and india-rubber connector perfectly tight. With a little practice the drawing out is easily effected even with the hardest combustion tubes. When many nitrogen determinations are made, it will be found convenient to employ printed forms for logarithmic calculations, the logarithmic constants of reduction being printed upon the form itself in their proper places.—*American Journal of Science*, vol. xxxvii. p. 350.

A Suggestion on the Detection of Poisons by Dialysis
by Dr. A. T. MACHATTIE, F.C.S., &c., Glasgow.*

THE general importance of the process of dialysis, for the separation of crystalloid substances from complex organic mixtures, is so well known as to render it unnecessary for me to refer to it at this time. The suggestion which I am about to lay before you has reference principally to the difficulty of detecting poisons when mixed with the heterogeneous contents of the stomach or intestines of the animals to which they may have been administered; and, unquestionably, one of the most important applications of dialysis consists in the detection of poisons by its means in the animal system after death.

Experiments have been already made with the ordinary hoop dialyser, in which parchment paper acts as the membrane or septum to such an extent as may satisfy all of the simplicity and value of the process of dialysis, both in the detection of poisons and in investigations on physiological chemistry; but, when experimenting lately with a common dialyser, it occurred to me that in some cases it might be of advantage to employ the animal organ itself as the dialyser, using the coats of the stomach or intestines as the membrane or septum, and in this way avoid interference with the organs themselves until they had been subjected to investigation. This can the more readily be done, since the exterior of the stomach of animals is seldom coated with any appreciable amount of fatty matter, and, therefore, the whole preparation necessary seems to be to thoroughly wash the exterior of the stomach or intestines to be examined; for thereafter the organ may be at once exposed to the external action of pure water, as in the commonly pursued methods of dialysis. This manner of separating a poison need not entirely prevent the previous examination of the interior lining of the stomach, provided that the opening be made so as to enable the stomach to be afterwards suspended in water without mechanical leakage. The intestines of an animal supposed to be poisoned seldom require to be opened throughout their entire length, and, accordingly, a portion of them left unopened may be tied firmly at each end, washed carefully, and exposed to the external action of water for twenty-four hours, or longer if necessary, in the usual way.

I regret that want of time has as yet prevented me from testing this process thoroughly, to see how far it may be considered any improvement on the common method of working, but certain preliminary experiments which were made to determine the practicability of the method now suggested may be mentioned.

(1.) Into the reticulum or honeycomb bag of a sheep were placed three grains of arsenious acid, partly dissolved, but principally suspended, in one ounce of water. The organ was then carefully washed with distilled water, and afterwards almost completely immersed in

* Read at the meeting of the British Association at Bath.

ten ounces of water, contained in a glass beaker. At the end of twenty-four hours the liquid in the beaker was greenish in tint, due to the colouring matter of the grass with which the various stomachs of the sheep were nearly full when the animal was killed. One half of the liquid, or about five ounces, was treated with hydrochloric acid, which caused a precipitation of white flocculent matter. The acid liquid was filtered from this precipitate, and then saturated with hydrosulphuric acid, when a slight precipitate of tersulphide of arsenic was obtained. Another portion, tested by Reinsch's process, gave abundant evidence of the presence of arsenic. No evaporation of the external liquid was required in either instance.

(2.) Into a portion of the duodenum of the same sheep, one-half of a grain of arsenious acid was placed, dissolved and suspended in water, as in the preceding experiment. This part of the duodenum, after being washed, was tied at each end, and suspended in eight ounces of water, in such a manner as to keep the tied ends entirely out of the water, and so prevent the contents from escaping by any opening that might still exist. The liquid became greenish, as in the first case, and after twenty-four hours yielded arsenic by Reinsch's process; but no appreciable precipitate was obtained by treating the liquid with hydrochloric and hydrosulphuric acids.

(3.) Three grains of strychnine dissolved in one ounce of water, with the addition of a few drops of hydrochloric acid, were added to the contents of the osmasum or manyplies of the sheep, and when suspended in water for twenty-four hours, as before, strychnine was detected in the external liquid. In this instance, however, it was necessary to evaporate the liquid; and as the presence of organic matter prevented the application of the colour tests for the alkaloid, ether was required to separate the strychnine in a state pure enough to be recognised. Bichromate of potash and sulphuric acid gave evidence of the strychnine by the characteristic violet tint, and the bitter taste was easily observed.

The above experiments are not adduced as in any sense conclusive of the value of the suggestion now made for the detection of poisons, but they show that arsenic and strychnine pass readily through the walls of the stomach and intestines of a dead sheep; and considering that the structure of the stomach and intestines of the higher animals is very nearly alike in all, and that so many of the commonly used poisons are crystalline like the two selected for experiment, it may safely be assumed that other crystalline poisons may be detected in other animals in a manner precisely similar to that described above.

The quantity of poison used in the above experiments is large—larger than what may be expected to occur in the body of many poisoned animals; and it is therefore possible that with minute traces of poison this process of detection might fail. On this head I can say little or nothing as yet, having had no opportunity of pursuing the investigation to any length, but I hope to be able soon to vary the experiments, and satisfy myself whether the process can be considered an improvement on those already known, or even advisable in practice at all. One remark may be made on the time of exposure. The only limit in this respect appears to be the length of time before putrefaction takes place. Twenty-four hours is probably the minimum which should be trusted, and the maximum time will depend on the temperature and season, because putrefaction will more or less rapidly destroy the dialysing membrane.

In conclusion, it appears to me that many problems in physiological chemistry might be better elucidated by the process just suggested than by using an ordinary hoop dialyser. In discovering, for example, what portion of the contents of the stomach or intestines of an animal pass through the walls of the organs with the greatest rapidity, it would surely be better to take the stomach or other organ exactly in the condition in which we find it in the animal, and without unnecessary mixture of, or interference with, its contents, and also without any exposure to air, which must produce some change, treat it with water externally at once, and thus prevent the influencing of the results by unnatural treatment, which cannot be avoided in the usual process.

A Physical Analysis of the Human Breath.

IN the August number of the *Philosophical Magazine* is a paper on "A Physical Analysis of the Human Breath," by Mr. W. F. Barrett, assistant in the Physical Laboratory of the Royal Institution. The experiments were made by the desire, and under the direction, of Professor Tyndall. The mode of analysis is founded upon the calorific absorption exerted by the carbonic acid contained in breath, the apparatus used by Mr. Barrett being mainly the same as that employed by Professor Tyndall in his researches on the absorption of heat by gaseous matter.

With ordinary sources of heat carbonic acid is probably the most feeble absorbent among the compound gases; but in a memoir which Professor Tyndall read before the Royal Society in March last it was shown that when a carbonic oxide flame is used as a source of heat, carbonic acid instantly reverses its position, and exceeds all other gases in its heat-absorbing power. Mr. Barrett has applied this fact to the determination of carbonic acid in those cases where small quantities of that gas are present. The paper he has published shows the result of his experiments upon air and breath.

The method of experiment is as follows:—A small flame of carbonic oxide is caused to burn regularly within a glass globe. The globe on one side has an aperture opposite the flame; this allows the radiation to pass unchanged into a brass experimental tube, which is mounted horizontally in front of the lamp. This tube is 49.4 inches long, and has its ends stopped air-tight by plates of rock-salt; it is also connected with an air-pump, so that it can be exhausted at pleasure.

The radiation from the flame after passing through the experimental tube, which has been well exhausted, falls on a thermo-electric pile, deflecting the needle of an attached and most delicate galvanometer. This deflection is neutralised by placing before the opposite face of the pile a cube containing water kept boiling; and by the careful adjustment of a double metal screen the needle is caused to stand precisely at zero.

If an absorbent gas be now admitted into the tube, the balance is destroyed, and, from the predominance of the cube source, the absorption by the gas in the tube can be calculated. If the gas has no energy as an absorbent the needle remains at zero.

Pure dry air tried in this manner showed no absorption, but common air gave an absorption of 15 per cent. of the total radiation; air deprived of its aqueous vapour, but retaining its carbonic acid, gave 13.8 per cent. absorption; whilst air bereft of its carbonic acid, but retaining its aqueous vapour, gave only 6.4 per cent.

Variations in the amount of carbonic acid present in the air can be detected by this method, as is shown by comparing air from Brighton downs with air from the laboratory, the absorption in the latter case being upwards of 4 per cent. greater than that in the former.

These experiments led the way to the subject of the paper. Four bags are filled at different periods with air from the lungs. After the breath has been dried by passing over sulphuric acid, the absorption by each specimen is separately examined and compared with a chemical analysis made by Dr. Frankland. In each case increase in absorption is found to accompany increase in the amount of carbonic acid. Upwards of 50 per cent. of the whole radiation from the flame was cut off by filling the tube with air from the lungs, the small amount of carbonic acid present being the only agent that intercepts so large a quantity of heat.

A series of experiments are then recorded, which have for their object the exact quantitative measurement, by physical means, of the carbonic acid contained in the human breath.

This is finally accomplished in the following manner:—A certain amount, about $\frac{2}{3}$ of an atmosphere, of pure air is caused to enter the experimental tube; the air by itself gives no absorption. One inch, or the thirtieth of an atmosphere, of dry carbonic acid is then added to the air; the needle of the galvanometer now shows a marked deflection, which is carefully noted. The amount of carbonic acid in the tube is then increased by, say, a tenth of an inch, the needle shows a higher deflection; this is again noted. The quantity of carbonic acid is thus gradually augmented, until its absorption—found from the deflection—is equal to the previously determined absorption by one of the specimens of breath. When this occurs, the whole amount of carbonic acid admitted into the tube is accurately read off from the barometer gauge attached to the air-pump. The breath having been tried at a uniform pressure of an atmosphere, a simple proportion gives the percentage of carbonic acid in it, supposing, as is the case, this gas to be the only heat-absorbing agent in the breath.

It will be noticed that the carbonic acid in the tube is there in the same condition as it is found in breath—namely, mixed with a large quantity of air. The presence of this air was found to be important, for although by itself the air is inert as an absorbent, yet twenty inches of it raised the absorption by the carbonic acid about 4 per cent. The cause of this is very interesting. The author believes that a portion of the carbonic acid gas when admitted into the tube alone, condenses on the interior and polished surface of the brass experimental tube, “the entrance of dry air removes the film, and consequently throws a larger amount of gas in the path of the rays from the source.”

The author then sums up his various experiments, and gives, in Table xiii., a succinct view of the absorption by a mixture of carbonic acid and pure air, the tension of the former ranging from 0.5 of an inch to 2 inches. From this table is calculated the percentage of carbonic acid in eight different specimens of human breath, the absorption by thirty inches of each specimen having of course been already determined. Dr. Frankland analysed by the usual chemical method four of these specimens, and in the next table, which we subjoin, the author compares in the last two columns the percentage he has obtained with that found by Dr. Frankland. The other figures in the table will explain themselves.

Bag No.	Absorption per 100		Tension of CO ₂ in parts of an inch.	Percentage of carbonic acid found	
	By 30 in. of breath.	By pure carbonic acid and dry air.		By physical analysis.	By chemical analysis.
1	50.6	50.7	1.2	4.00	4.311
2	52.8	52.6	1.4	4.66	4.556
3	53.7	53.7	1.55	5.16	4.061
4	54.0	54.0	1.6	5.33	5.212
5	50.0	50.0	1.15	3.83	
6	52.7	52.6	1.4	4.66	
7	50.0	50.0	1.15	3.83	
8	52.1	52.0	1.3	4.33	

Here in three cases is a very close agreement between the physical and chemical analysis, close for so novel a method. In the case of bag No. 3 the difference is somewhat great. The cause of this is, however, satisfactorily explained by the author.

The table shows that the principle upon which the determinations rest is certainly correct and also practical. Repeated experiments, bringing greater experience, would probably cause the differences between the two modes of analysis entirely to disappear.

But, in the end, what advantages does the physical method adduce for its support? The facts revealed by the numerous tables leave no doubt on our mind that it is evidently a more delicate test of the existence of carbonic acid than the present chemical means. As such it will be of service in many cases where chemical analysis would fail. If a simple and ready mode of making a physical analysis of breath can be devised, this new method will undoubtedly be most useful in hospitals and elsewhere.

PHYSICAL SCIENCE.

*On the Spectra of some of the Heavenly Bodies, by Dr. MILLER and Mr. HUGGINS.**

A PORTION of this paper—that relating to the spectra of the planets—has already appeared in the CHEMICAL NEWS, but the concluding part made known one of the most interesting discoveries of modern times. It related to the spectra of nebulae, the observations on which were said to have been conducted solely by Mr. Huggins. The nebulae observed were chiefly those denominated planetary, because of their close resemblance to planetary discs. They have hitherto been regarded as probably clusters of stars, which, by mutual proximity and vast distance, are reduced to the form of discs. In the observation of these Mr. Huggins had many difficulties to overcome.

It was not thought that the light of these bodies would be sufficient to produce any spectrum at all; nor would it have done so had their construction been that which has been usually assigned to them. But what was the surprise of the observer to behold, not a continuous spectrum such as that which proceeds from a solid body interspersed with dark lines due to atmospheric absorption, but a spectrum consisting of a few bright lines such as that which proceeds from an intensely-heated gas. It was, indeed, the smallness in number of these component lines that enabled any success to be obtained; and the result from one of these nebulae revealed the astounding fact that it was probably composed of hydrogen and nitrogen without any solid nucleus whatever. But what is the origin of this high temperature, since we are sure, from the conservation of energy, that some other form of

* Abstract of paper read before the British Association.

motion must be destroyed in order to produce the luminosity? The origin of the light of the heavenly bodies thus becomes more perplexing than ever, and seems to point to some law regarding which we are yet in the dark.

PHARMACY, TOXICOLOGY, &c.

On the Medicinal Muds of the Island of Ischia (Bay of Naples), by Dr. T. L. PHIPSON, F.C.S., &c.*

Two specimens of these muds were forwarded not long ago to my laboratory in London, in order to be analysed. I believe they were brought to England by Colonel Stuart Wortley. Invalids visiting Ischia plunge their arms, legs, or entire bodies into these muds for various diseases, more particularly for scrofula and rheumatism; they are supposed to have a peculiar healing power. It was, therefore, interesting for me to submit them to a careful examination.

One of the bottles containing the specimens was ticketed *Fango del Gurgitello*, the other *Fango dell Arita*. They differ very much in appearance and in smell, though they are essentially the same in composition, being formed of the volcanic or feldspathic grains resulting from the destruction of the rocks of the district. The whole constitutes a volcanic sand, rendered muddy by water, and a certain amount of vegetable *débris*. The grains are composed of lava, green feldspar, ryacolite in beautiful glassy grains, augite, quartz, mica, and here and there a few fragments of marble, &c. My analysis of these muds gives them the following composition:—

<i>Fango del Gurgitello.</i>	<i>Fango dell Arita.</i>
Greenish grey; no smell; insipid; sandy, with little mud. Deposits sulphur on a plate of silver in twenty-four hours.	Black; smell of putrid algæ and sulphuretted hydrogen. Gives PbS on paper imbibed with acetate of lead when heated.
Water 30.00	Water 42.85
Organic matter . . . 4.00	Organic matter . . . 4.05
Oxide of iron 1.40	Black sulphide of iron 1.36
Carbonate of lime . . 1.20	Oxide of iron 2.00
Bromine and iodine . none	Carbonate of lime . . 2.60
Sulphur traces	Bromine and iodine . none
Volcanic sand as above described 63.40	Sulphur { notable quantity.
100.00	Volcanic sand 47.14
	100.00

The Italian bottles in which these specimens of the Ischia muds were sent to me, though corked with large glass stoppers, do not close hermetically, and I have no doubt that the water of these muds, in its natural state, is strongly impregnated with sulphuretted hydrogen, which has almost entirely escaped during the journey. It is doubtless to the presence of sulphur that the muds owe some of the medicinal properties ascribed to them, as it is the only active substance present in them. The black colour of the mud *dell Arita* is owing to a layer of black sulphide of iron formed by the sulphuretted hydrogen upon the grains of green feldspar, which it envelopes completely; when the mud is exposed to the air for some time the black sulphide is gradually oxidised, and the grains assume their original green colour. In this manner the *fango dell Arita* becomes similar to the *fango del Gurgitello*.

It is remarkable that sulphuretted hydrogen—like carbonic and sulphurous acids—attacks the iron oxide of

the feldspar rocks in preference to the alkalies, which are not attacked at all, for the glassy grains of ryacolite have undergone no decomposition whatever. Diluted hydrochloric acid dissolves this black sulphide of iron formed on the surface of the green grains, with evolution of sulphuretted hydrogen.

No bromine or iodine could be detected in either of the sands, but by passing a magnet through some of the Arita mud, a number of brilliant black grains adhered to it, and were proved to be magnetic oxide.

The water separated by filtration from the sand, &c., merely gave indications of lime, sulphates, chlorides, &c., and did not differ from ordinary river water, except by the presence of a small proportion of free sulphuretted hydrogen, which, in that of the *fango dell Arita*, only amounted to $\frac{6}{100000}$ ths; but, as stated already, I believe the greater portion of this gas had escaped during the journey.

The curious custom of plunging the body into muds of this kind as a means of restoring health is not confined to Ischia; I have lately mentioned in the *Geological Magazine* a similar custom prevailing on the shores of the salt lake Balta Alba in the Danubian provinces; I have also heard of a similar practice being carried out in the South of England.

The beneficial results that are said to follow this treatment are probably owing as much to the cleansing and stimulating effect produced by the friction of the grains of sand upon the skin, as to the presence of sulphur in the muds.

On the Extraction and Preservation of Aromata, by C. R. C. TICHBORNE, F.C.S., Chemist to the Apothecaries' Hall of Ireland.*

OBSERVING the preservative powers of glycerine for vegetable substances, the author packed different kinds of scented flowers in jars, and covered them with glycerine. In this way he had kept some for two years. If flowers, &c., so preserved be pressed, it is found that the glycerine has absorbed all the volatile oil, and when diluted and distilled furnishes a water in all cases superior to that from flowers preserved by salt. If the odoriferous glycerine be diluted and agitated with oils or fat, ointments, &c., of excellent quality are produced. In all these cases the glycerine is recovered by mere evaporation of water from it. The delicate oils of orange, jasmine, heliotrope, &c., are best isolated by steeping the flowers in the glycerine, pressing, and again steeping more flowers, and so on; finally diluting with water and shaking with chloroform, which removes the oil. The low boiling point of the chloroform admits of its being separated from the oil by a temperature which does not injure the oil.

In the course of a discussion which followed the reading of the paper, Mr. D. Hanbury remarked that the objects of the author were divisible into two classes, firstly, the preparation of distilled waters, and secondly, that of the more delicate volatile oils. He feared that the cost of pure glycerine and the difficulty of recovering it would prove serious obstacles to such a process. For the second purpose that had been named, a better method was required than the system of *enfleurage*, now in use in the South of France, &c. His friend, Dr. De Vry, when travelling in Java, had extracted the delicate odoriferous principle of some species of jasmine, *Pandora odoratissima*, &c., and by the use of ether got minute quantities of butyraceous volatile oils. It would

* Read before the British Association, 1864.

* Read at the meeting of the Pharmaceutical Conference.

be an important desideratum if this method would answer in such cases, and he (Mr. H.) was satisfied that it well deserved more extended investigation.

Other speakers advocated the use of pickled elder flowers in the preparation of elder flower water.

*On Commercial Carbonate of Bismuth, by Mr. C. UMNEY.**

COMMERCIAL carbonate of bismuth having been suspected to be contaminated by basic nitrate, the author had analysed six samples, and gave in his paper the numerical results. In one case no nitrate was present, and the other five contained but small and probably accidental quantities.

In preparing carbonate of bismuth, by precipitating a solution of the nitrate by an alkaline carbonate, carbonate of soda was preferable to that of potash, but carbonate of ammonia with subsequent ebullition yielded the purest precipitate.

*On the Pharmaceutical Applications of Glycerine, by Mr. F. BADEN BENGER.**

IN this paper a short history was given, and a *résumé* of its applications in pharmacy. The preparations known as "plasma," in which glycerine with starch is substituted for lard, as a basis of ointments, had been made the especial subject of experiment by the author. He had found *tous-les-mois* starch superior to any other in making the simple plasma. Fifty grains of *tous-les-mois* was to be rubbed with one ounce of glycerine, and the mixture heated to 240° for a few minutes or till it became translucent. He thought that plasma might replace lard in ointments having a tendency to become rancid, but its relatively great expense would preclude its general adoption. The glyceroles, or solutions of different substances in glycerine, were then noticed. A good "tincture of myrrh and borax" could be made by dissolving one part of borax in two of glycerine, and adding tincture of myrrh. As substitutes for syrup, the glyceroles did not appear to possess any superiority. Its use as an excipient in pill-making was strongly advocated.

*On Commercial Phosphoric Acid, by R. PARKINSON, Ph.D.**

TWENTY-EIGHT samples had been examined with reference to their strength and freedom from impurity, the result as to strength being that three samples came up to the British Pharmacopœia strength, five more were about the London Pharmacopœia strength, while the remainder were of various shades of declension. Phosphate of ammonia was present in six samples, sulphuric acid in one, nitric acid only traces in any. The presence of ammonia was considered evidence that the samples containing it had been made from the glacial acid, which, commercially, is made by heating the phosphate of ammonia, the whole of the ammonia never being practically got rid of. One sample of German glacial contained 5 per cent. of ammonia, which is equal to 17½ per cent. of tribasic phosphate of ammonia. If a pure glacial acid could be readily obtained, commercially, that was suggested as the best and safest means of obtaining the dilute acid, and the combustion of phosphorus, with arrangements for the supply of air and collection of acid, was suggested as the best mode of obtaining such a pure glacial acid. Other plans for its preparation, which were detailed, had been tried, and found satisfactory.

* Read at the meetings of the Pharmaceutical Conference.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, October 5.

Mr. SANDFORD, President, in the Chair.

THIS was the first Pharmaceutical meeting of the session, and was, as usual, devoted to the distribution of the prizes obtained in the classes of the preceding session. On opening the business, the President expressed the pleasure he felt at the recommencement of the evening meetings. On these occasions the members met as a society for mutual improvement, and he hoped the present session would afford no less instruction than past sessions. There were many subjects waiting for discussion. The British Pharmacopœia—much as was said about it last session—was still unexhausted. It had been reported that a new edition would be issued, but he believed the report to be incorrect, and it was therefore necessary that the members should come to some understanding as to which Pharmacopœia should be in use. At the present time, a patient might have a prescription made up in one establishment with Infusion of Gentian P.B., and in another with the infusion made according to the London Pharmacopœia, and one or the other was sure to be accused of a mistake. The members, therefore, ought to come to an understanding as to which they would work by. The poison question was also a subject which deserved their serious attention. The members were aware that the Medical Officer of the Privy Council had made a Report to the Government, and other things tended to show that some legislative interference would be attempted in the next parliamentary session. The subject was confessedly a difficult one, but he thought the members would see the advisability of meeting the views of the public and of some in authority, who seemed to think it very easy to ensure the safe custody and sale of poisonous substances. He did not know whether or not it would be advisable to introduce a poison clause into the Pharmacy Bill the Society hoped to carry through next session; but, he repeated, something must be done to meet the public views. That druggists were not always to blame for deaths which had been ascribed to their carelessness, was well shown by a case which he believed was referred to in Dr. Taylor's Report. It was that of a man who bought four ounces of Epsom salts of one druggist, and half a pound of oxalic acid of another. He then emptied the Epsom salts from the papers, replaced them with oxalic acid, and then poisoned himself. The substitution was afterwards proved by the circumstance that some crystals of Epsom salts were found remaining in the folds of the paper, and thus the druggist was acquitted of blame, and the fact of suicide established. The case was suggestive, and showed what frauds druggists were open to. With regard to the immediate business of the evening, the President observed that it afforded him peculiar pleasure. It was always pleasant to be brought face to face with successful men, and, moreover, he thought it would show that the Society was working well, and had worked well.

Professor REDWOOD then presented his Report. He said that after performing a similar duty for twenty years, he found it difficult to find anything fresh to say. He must report the same good conduct and diligence on the part of the pupils, and with regard to their progress he must remark that the standard at these examinations had greatly advanced. Much more was expected of pupils now than used to be expected; the questions given out were much more difficult than they were twenty years ago. In accounting for diminished attendance in classes and the laboratory, it should be remembered that the Society had now for many years sent out numbers of qualified instructors, and that candidates came from them ready prepared to pass the examinations of the Society. On the whole the retrospect afforded him great satisfaction.

Professor BENTLEY and Dr. ATTFIELD then presented their reports, and expressed the same satisfaction with the progress and good conduct of their classes. Each Professor read the prize questions, which we append:—

Chemistry and Pharmacy—Dr. Redwood.

1. What are the respective weights of a pint of each of the following liquids:—Rectified spirit, proof spirit, chloroform?

2. What is the meaning of the term "specific heat;" how is the specific heat of bodies determined; and what is the specific heat of olive oil as compared with water?

3. What is meant by the term "dialysis?" Describe the method of conducting the process to which this name is applied, and mention some of the results which have been obtained by it.

4. Describe the preparation and properties of phosphorus and phosphoric acid.

5. State the sources from which bromine is obtained, and describe the method of isolating it, and also its properties and atomic weight.

6. Name the body represented by the formula C_2NH , and describe its properties and tests.

7. Give the atomic formula for urea; describe the method of producing it artificially, and the nature of the change effected by the application of heat to it.

8. Describe the processes of the British Pharmacopœia for the preparation of emetic tartar and hydrochlorate of morphia.

Medal, Mr. Watts; Certificate of Honour, Mr. Bingley and Mr. Passmore; Certificate of Merit, Mr. Golding and Mr. Hemmingson.

Materia Medica and Botany—Professor Bentley.

1. Describe the physical and chemical characteristics of chlorophyll. State where it is found, the conditions favourable to its development, and the changes which it undergoes at the different seasons of the year.

2. Define the following:—Bulb, corm, rhizome, tuber, and tubercule. Mention the various substances of the Materia Medica which present illustrations of them respectively, and name the plants which yield them, and the natural orders to which they belong.

3. Define the following terms:—Parasite, epiphyte, serrate, ligule, cupule, involucre, panicle, hypogynous, syngenesious, isomerous, gynandrous, and tetradynamous.

4. What are the substances required for the support of plant-life; and in what manner are they taken up by plants?

5. Describe the physical and chemical characteristics of both colchicum corm and seeds, and state the time of the year in which they should be collected for use.

6. Mention the officinal plants of the British Pharmacopœia derived from the *Ranunculaceæ*. Mention the botanical and geographical sources of podophyllum rhizome, and describe its physical and chemical characteristics.

7. Describe the physical characteristics of croton seeds; state their botanical and geographical source, the manner in which croton oil is obtained, and the differences between East Indian croton oil and English Croton oil.

8. Give the essential characters of the following natural orders, and enumerate the officinal plants of the British Pharmacopœia which they respectively contain:—Cruciferae, umbelliferae, atropaceae, polygonaceae, iridaceae, and melanthaceae.

Medal, Mr. Watts; Certificate of Honour, Mr. Bingley and Mr. Passmore; Certificate of Merit, Mr. Hall, Mr. Hemmingson, and Mr. Squire.

Practical Chemistry—Dr. Attfield.

1. You are furnished with four unlabelled pharmacopœial preparations; analyse and name them.

[The preparations were—1. White precipitate; 2. Syrup of phosphate of iron; 3. Distilled water; 4. Dilute nitric acid.]

2. Examine the specimens of calomel, sulphur, sulphate of quinine, hydrochloric acid, and chloroform, supplied to you, and report on their quality.

[The calomel contained 1 per cent. of bichloride; the sulphur 37 per cent. of sulphate of lime; the quinine 10 per cent. of sulphate of quinidine; the hydrochloric acid was contaminated with arsenious acid; the chloroform was pure.]

3. The solutions marked A and B may contain any of the ordinary salts used in medicine; analyse them, and state the result.

[A. Disulphate of quinine; B. Perchloride of iron.]

4. The powder given to you is also a mixture of medicinal salts; examine it, and state its composition.

[Bitartrate of potash and oxalic acid.]

Medal, Mr. Watts; Certificate of Honour, Mr. H. W. Smith; Certificates of Merit, Mr. Goolden, Mr. Passmore, and Mr. Bingley.

The PRESIDENT then presented the Pereira Medal, the highest honour the Society offered, to Mr. Watts, and expressed his hope that Mr. Watts would meet with as much success in the active pursuits of life as he had met with in his career as a student.

Mr. WATTS briefly returned thanks to the Professors on the part of the students.

The other prizes distributed were as follows:—Herbarium Prizes.—Medal, Mr. Thorne; Certificate of Merit, Mr. Collyer. Senior Bell's Scholarship, Mr. Watts; Junior do., Mr. Harris. Minor Examination Prize of Books, equal in value to 2*l.*, Mr. J. Mayfield (Miller's "Chemistry").

Professor BALFOUR, of Edinburgh, then addressed a few words to the meeting expressing the pleasure he felt at being present on the occasion; and the satisfaction he and every one else must feel at the result of the examinations. These, he was glad to see, were of a decidedly practical character, as all examinations of the kind should be. The Edinburgh branch of the Society was pursuing a similar course with great success.

As the usual time to adjourn had not arrived, Dr. ATTFIELD read a paper entitled "*Contributions to the History of Balsam of Peru*," a report of which we defer.

ACADEMY OF SCIENCES.

October 3.

THE second part of a memoir by M. Kuhlmann "*On the Crystallogenic Force*" was read. It related to the crystallisation of metals, the formation of mineral concretions, geodes, and arborizations in marbles, agates, &c. Under the first of these divisions the author spoke of the molecular change which iron subjected to concussions undergoes, and the consequent danger to the axles of wheels. M. Kuhlmann asserts that boiler-plates undergo the same change from the concussions of ebullition, and hence a frequent source of explosions. He suggests the following simple way of testing boiler-plates:—Clean a few square inches from oxide, and polish it with a fine file. Then act on the surface with nitric acid for some minutes. If, after washing, any crystalline structure be revealed, M. Kuhlmann thinks it will be well to have the boiler tested by hydraulic pressure. There are one or two other practical points in the paper to which we shall return.

Another paper was, "*On the Spontaneous Decolorization of Tincture of Litmus*," by M. Meunier. The author thinks this is due to the action of microphytes.

Messrs. Churchill's Literary Announcements.

—The Messrs. Churchill write to correct an error in our paragraph last week. The "*Principles and Practice of Medical Jurisprudence*," by Dr. Taylor, is an entirely new work, and not a new edition of the Manual. It is a separate and complete treatise on the subject, and will be illustrated with numerous woodcuts.

NOTICES OF BOOKS.

Treatment of Consumption; with Remarks upon the Properties and Uses of various Remedial Agents. By MATTHEW CORNER, M.D. London: Hardwicke. 1864.

Letters on the Lungs, &c., &c. By ROBERT HUNTER, M.D. With a Preface by J. J. MACGREGOR, M.D., &c. London: Mitchell and Co. 1864.

THESE books lie beyond our critical cognisance, but we regard them as hopeful signs of the times, notwithstanding the wide difference of opinion which exists between the two writers. Dr. Corner regards consumption as a disease allied to rheumatism, to be cured mainly by the administration of carbonate of soda. Dr. Hunter looks on the same disease as a purely local one, caused by imperfect oxygenation of the blood, and hence to be cured by the inhalation of oxygen, and other remedies applied topically in the same way. We shall leave the medical profession to decide as to the correctness of these views, and content ourselves with stating that readers may gather hope at least from the perusal of the books, and patients possibly benefit from the adoption of the remedies.

Dr. Corner's book contains some useful hints on diet, ventilation, and other hygienic measures, which may be attended to with great benefit. The letters of Dr. Hunter are written in a lively style, and intended for popular reading; and, considering the commonness and fatal nature of the diseases of which they treat, we have no doubt they will have a wide circulation.

A Companion to the British Pharmacopœia: comparing the Strength of the Various Preparations with those of the London, Edinburgh, and Dublin, United States, and other Foreign Pharmacopœias: with Practical Hints on Prescribing. By PETER SQUIRE, F.L.S. (Second Edition.) London: Churchill and Sons. 1864.

THIS new edition of Mr. Squire's successful book is so much enlarged and improved as to deserve a separate notice as a new work. In the first place, the size has been increased by forty-eight pages—almost a fourth of the original work—by the addition of new matter, and without disturbing the arrangement. The greater part of the new matter consists of formulæ "not officinal," for numerous preparations in common use, and so giving information of great value to chemists and druggists.

In our notice of the first edition we pointed out the distinctive characteristics of the book, and need not repeat them here; but one addition has been made which must not be passed over without commendation. A complete index has been added, which at the same time serves as a posological table, the dose being appended to the name of every internal remedy, whether officinal or not. We may suggest to Mr. Squire *en passant* that he might publish much of the new matter with an index for the first edition in a separate form for the convenience of the purchasers of that edition.

We have only to add that Mr. Squire has made the best book on the British Pharmacopœia much better and more useful.

Annalen der Chemie und Pharmacie. September, 1864.

THIS number of the *Annalen* contains a paper "On the Bromine Compounds of Nicotin," by Dr. Carl Huber. Bromine acts on nicotine with great violence; but by operating carefully with solutions in alcohol or ether a variety of products are obtained. The author has determined the composition of some of these, and among them a red crystalline mass obtained by operating with ethereal solutions of bromine and nicotine. This he found to have the composition $C_{10}H_{13}N_2Br_5$. From this compound, by treatment with potash or ammonia, bromnicotin $C_{12}H_{12}Br_2N_2$

is obtained. This body is a weak base, which precipitates most metallic oxides from these solutions, and forms crystallisable compounds with acid salts. The author also describes a compound of hydrobromic acid and bromnicotin. A short notice is also given of the iodine compounds of nicotin.

The next paper is by C. Oeser, "On Pimento Oil." E. Dollfus, in a paper "On Cetylic Compounds," describes the acetate, butyrate, and valerianate of cetylic, and also cetyl-aldehyd. A. Baeyer gives a continuation of his "Researches on the Uric Acid Group." Tollens and Fittig communicate an interesting paper "On the Synthesis of Hydrocarbons of the Benzole Series," and describe the methods of obtaining methyl-phenyl, ethyl-phenyl, and amyl-phenyl. Methyl-phenyl the authors consider identical with toluol. They combat some of the views expressed by Schorlemmer in his paper on alcohol radicals, and express their belief in the possibility of preparing all the radicals of the ethyl series from the benzol series.

A paper by Dr. Moldenhauer follows "On the Substitution Products of Glycerinic Acid." From this acid he obtained iodopropionic acid, and from the latter he procured hydroacrylic and lactic acids. By the dry distillation of glycerinic acid the author procured pyrotartaric acid and pyrotartaric anhydride.

Dr. A. Beyer describes the composition and properties of "Oxygummic Acid" obtained by Reichardt in the reaction of oxide of copper and potash on sugar. He regards it a tribasic acid, having the formula $C_6H_8O_{16}$.

A short paper by O. Popp gives "A Method of Separating Cerium from Lanthanum and Didymium," which we shall give at length. The same author describes a peroxide of nickel and of cobalt, which he obtains by treating a salt of the first metal with acetic acid, and then adding hypochlorite of soda. On boiling such a mixture the peroxide of nickel separates as a deep blue coloured powder. A similar solution in the case of cobalt requires the addition of an alkaline carbonate to precipitate the peroxide in the form of a dark greenish brown powder. In another paper Popp gives reasons for believing that wasium oxide, as described by Bahr, is a mixture of yttria and oxide of cerium. Delafontaine, in a short notice "On Wasium," states his belief that wasium is identical with cerium. Kaemmerer, in another short paper, gives his reasons for believing that the acid he discovered and named *isomalic* is not identical with diglycolic acid, as is supposed by Friedel and by Heintz. The other papers in this Journal have already appeared either in abstract or at length in the CHEMICAL NEWS.

Journal für Praktisches Chemie. September, 1864.

THE number opens with a paper "On the Quantitative Estimation of Fluorine in some Bohemian Minerals," by Kobell. Another follows by Dr. Zangerle, entitled "Chemical Researches on the Mineral Waters of Tiefenbach." All the other papers of any interest have already been noticed in the CHEMICAL NEWS.

The American Journal of Science and Arts. September, 1864.

THE chemical papers in this number of Silliman's Journal include a continuation of Mr. Sterry Hunt's "Contributions to Lithology," in which he gives analyses of various Canadian rocks. Some "Notes on the New Almaden Quicksilver Mines," by R. Silliman, jun., will be of interest to miners. The author shortly describes the simple process and apparatus employed in distilling the mercury which in San Francisco, it seems, sells for 75c. per lb., while in London and New York it only fetches from 40c. to 50c. per pound. The process is simple distillation from large brick furnaces, capable of holding 60,000 to 100,000 lbs. of the ore. The condensers are lofty, capacious chambers of masonry. Under the furnaces, which are

built upon brick arches, are plates of iron, to prevent loss of mercury. Before this precaution was adopted, much of the metal was lost in the earth, and in a single year 2000 bottles were recovered from the foundations of two furnaces. Professor Norton continues his paper "*On Molecular Physics*," and in this part gives his theory of crystallisation, to which we may refer on another occasion. There are also some novel views on some of the phenomena of light, heat, and electricity. Mr. Carey Lea concludes his "*Notes on the Platinum Metals*," devoting this part to the "*Reactions of the Platinum Metals*," and giving "characteristic criteria for all those cases in which it has been considered most difficult to discriminate" between the metals. The paper is of great practical value, and we shall publish it entire. There are several other papers of great value on different branches of science, and the present number fully sustains the high character of the journal.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

1362. Frederick Oldfield Ward, Hertford Street, Mayfair, Middlesex, "Improvements in the manufacture of chromic acid and chromates."—Petition recorded June 1, 1864.

2222. James Williams, Broad Quay, Bath, Somersetshire, "Improvements in apparatus connected with fermenting, charging, cleansing, or tunning vessels, casks, or vats."—Petition recorded September 12, 1864.

2230. Harold Potter, of Manchester, "Improvements in bleaching fibrous substances."—Petition recorded September 13, 1864.

2252. Alfred Vincent Nugent, Chancery Lane, Middlesex, "An improved mode of, and apparatus for, preventing incrustation in steam boilers."—A communication from George Tracy Parry, Philadelphia, U.S.A.

2256. Manuel Leopold Jonas Lavater, Bath-street, Newgate-street, London, "Improvements in the manufacture of driving straps or belting, and of tubes of vulcanised india-rubber, and also in the manufacture of the helical coils of wire commonly inserted in vulcanised india-rubber tubes, also in desulphurising articles of vulcanised india-rubber."—Petitions recorded September 15, 1864.

2260. John Hawkins Simpson, Kilmeena, Ireland, "Improvements in printing by electricity for telegraphic and other purposes."—Petition recorded September 16, 1864.

2276. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in artificial fuel."—A communication from Paul Baudet, Paris, France.

2278. Frederick Yates, Birmingham, Warwick, "Improvements in the manufacture of iron and steel."—A communication from Dr. Adolph Gurlt, of Bonn, Prussia.

2282. John Hamilton Burns, Glasgow, Lanark, N.B., "Improvements in the distillation of volatile minerals, vegetable and other organic matters."—Petitions recorded September 17, 1864.

2289. Augustus Figge, Kensal Green, Middlesex, "Improvements in the construction of safety-match and fusee boxes."

2294. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of phosphuret of iron, phosphate of lime, and alkaline phosphates."—A communication from Edouard Aubertin, Paris, France.—Petitions recorded September 19, 1864.

2298. William Laurence, Cornwall Villas, Paddington, Middlesex, "Improvements in apparatus for mashing and for cooling worts and other liquids."

2310. Edmund Smith, Hamburg, Germany, "Improvements in wet gas meters."—Petitions recorded September 20, 1864.

2320. Edward Young, Oughtibridge, near Sheffield, Yorkshire, "Improvements in the manufacture and application of fire-resisting cements and materials."—Petition recorded September 21, 1864.

2329. Thomas Walker and Thomas Ferdinand Walker, Birmingham, Warwickshire, "Improvements in means or apparatus for the utilisation of sewage matters, part of which improvements is applicable to raising and forcing other fluids."—Petition recorded September 22, 1864.

2339. William Palmer, jun., Southweald, Essex, "Improvements in the manufacture of candles."—Petition recorded September 3, 1864.

2359. Lewson Alexander and William Bryer Nation, West Ham Lane, West Ham, Essex, "A mode of separating the pitch and spirituous oils from all matters containing them."—Petition recorded September 26, 1864.

Notices to Proceed.

1335. Thomas Drew, the elder, Derby Villa, Tranmere Park, Birkenhead, "Improvements in the manufacture of paper, papier-mâché, and millboard."

1342. William Henry Newton, Chancery Lane, Middlesex, "Improvements in the treatment of the low or poor products obtained in the manufacture or refining of sugar."—A communication from Eugène Bertholomey, Rue St. Sebastien, Paris, France.—Petitions recorded May 30, 1864.

1349. James Young, Bucklersbury, London, "Improvements in the treatment or distillation of bituminous substances."—Petition recorded May 31, 1864.

1366. Oscar Eugen Prieger, Bonn, Prussia, at present residing at Manchester, "The manufacture of ferro-manganese and cupro-manganese, or alloys thereof, with other metals."—Petition recorded June 2, 1864.

1507. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for washing or dyeing skeins of thread, silk, cotton, or other fibrous materials."—A communication from Claude Viret, Boulevard St. Martin, Paris.—Petition recorded June 17, 1864.

2223. Henry Craven, Baildon, Edinburgh, "Improvements in the manufacture of inks or writing fluids, to be used with certain kinds of paper, for the prevention of fraudulent alterations in bankers' drafts, notes, cheques, and other documents in which it is important to avoid alteration or erasure."—Petition recorded September 12, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, October 11.

M. RICHTER, of Stuttgart, has devised a novel means of extracting the juice from grapes. Instead of pressing them in the ordinary way, he puts them in a drum provided with a suitable strainer, and rotating at the rate of 1000 or 1500 times a minute. The process is said to have the following advantages over the ordinary method:—The time required for the operation is greatly lessened, the whole of the must from 1 cwt. of grapes being obtained in five minutes; the quantity of juice is increased by 5 or 6 per cent.; "stalking" is rendered unnecessary; and the agitated must is so mixed with air that fermentation begins comparatively soon.

Physicists of the most modern school have been somewhat scandalised at M. Dumas for using the term "ether" in speaking of heat, light, electricity, and magnetism in his otherwise magnificent report on the progress of electrical science lately published in the *Moniteur* on the occasion of the award of the 50,000 francs prize to M. Ruhmkorff. *Cosmos* is very hard on M. Dumas for using the expression, and compares the ether theory with some old theatrical effect which has lost its brilliancy, and ought to be put away to rot in obscurity.

A discovery of a very interesting character has just taken place at Pompeii. In examining a certain small street M. Fiorelli perceived under a mass of rubbish a number of hollow places containing vestiges of bones. It immediately occurred to him that these hollows must have once contained the bodies of which the remaining bones formed part. He accordingly caused casts of the holes to be taken, by filling them with plaster of Paris, and was rewarded by obtaining almost perfect representations of four human bodies, in which the clothes, flesh, and hair were reproduced with startling exactitude. One of the bodies is that of a woman, near which was found several pieces of money and some jewels, evidently showing that the unfortunate creature had been overwhelmed as she was flying with her worldly treasures. The head-dress and the texture of her clothes are perfectly distinguishable. The left arm is raised, and the fingers are stiffened in an attitude of agony. The other bodies are those of another woman and a little girl, apparently mother and daughter, the fourth being that of a soldier. The stomachs of all four are greatly swollen, the mouths being open, as if they had been drowned. This gives the notion that the eruption must have been followed by a shower of water.

The *Société Imperiale d'Agriculture* has offered a prize of 2000 francs, to be given in 1867, for the best analyses of the following woods:—Oak (heartwood) of the age of at least forty years (*quercus robur* or *pedunculata*); ash (*fraxinus excelsior*), of the age of at least twenty-five years—the whole of the wood except the liber and bark; pine (*pinus maritima* or *silvestris*) of the same age, and poplar (*populus tremula* or *alba*) of the age of twenty years. Analyses of the same trees five years old are also to be made, with the view of comparing the composition of wood of different ages. Specimens of the woods and of the principles obtained from them, must be sent with each paper.

M. le Verrier is about to cause meteorological observations to be made in all the normal departmental schools throughout the country. M. Charière, a well-known meteorologist, is up in arms about this, and declares that if country schoolmasters' observations are to be relied upon, he will break his instruments and never make an observation again. This is vulgarising science with a vengeance.

In absence of any more interesting news, let me send you a little scandalous anecdote, which you must take *cum grano—cupri sulphatis*.

Not quite one hundred years ago the proprietor of the largest electro-metallurgical establishment near Paris addressed a most respectful letter to the French Academy, requesting that a commission might be sent to inspect his factory and report upon his process for depositing copper on cast or wrought iron objects, such as lamp-posts, statues, fountains, &c. He sent a number of specimens with the letter, but the Academicians either did not know or had forgotten the great encouragement that M. Cinquetoiles had received from the Emperor, and they left the meeting without looking at what had been sent for their inspection. However, in a few days it occurred to some one that the Emperor had taken this manufacturer under his particular patronage, and had been over his works several times. A commission was at once appointed, with a president, and secretary, and reporter, &c., &c., &c. They called at the works, inspected the process, praised everything they saw, and wandered about the place for several hours. At last the reporter, who is an illustrious professor, and the author of a standard "*Traité de Physique*," caught sight of a workman varnishing a lamp-post before putting it into the copper bath. The reporter asked the manufacturer what was the intention of this apparently useless operation. The manufacturer replied that if objects in iron were not varnished and then black-leaded, a good deposit could not be obtained. The man of science smiled, and reminded the manufacturer that old

birds, especially scientific ones, were not to be caught with chaff. If the manufacturer would only buy his "*Traité de Physique*," he would see that it was only necessary to blacklead the iron article to obtain a perfect deposit. The reporter then related the joke to his colleagues, who laughed and pitied the ignorance of the poor manufacturer, who in the meantime had picked up a piece of cast iron, and was blackleading it as if his life depended on it. The blackleaded iron was put into the copper bath and connected with the battery. A beautiful rose-coloured film of copper spread over the metal, and a triumphant smile over the faces of the lookers on. But shortly the rose-coloured copper changed to a dirty brown powder, and the triumphant smile to a look of perplexity. The surface of the iron at the end of ten minutes consisted of nothing but a dirty brown mixture of powdery copper and decomposed cast iron. The members of the Commission suddenly recollected that they all had particular appointments in different parts of Paris, and made a precipitate retreat from the factory. Strange to say, although a great number of notes were taken, no report has ever appeared, and the succeeding editions of the "*Traité de Physique*" still contain the same erroneous assertion that by merely blackleading cast or wrought iron it may be covered with copper to any thickness by plunging it into a bath of sulphate of copper, and making it the cathode of a voltaic series.

Position of Chemists and Druggists.

To the Editor of the CHEMICAL NEWS.

SIR,—I was pleased to see you drawing particular attention to the address of Mr. Deane at the Pharmaceutical Conference. In that address he states the case of the chemist with great fairness and honest boldness. Mr. Deane is one of the leaders of the Pharmaceutical Society who has never toadied to the "needless jealousy" of professional men, but has always contended for the legitimate rights of the chemist and druggist. A great effort has been made to raise a storm of obloquy against us, for a failing which probably happens less often to us than to prescribers. These have an advantage which compounders unfortunately cannot command. Some one comes after them who can correct their blunders. I, for example, have had some experience in dispensing—as much as most indeed,—and I am not conscious of having caused the death of a single individual. But I am confident that I have saved more than a dozen lives by detecting the mistakes of prescribers. I need not draw examples for my own experience from circumstances which happened years ago, but I will take two instances which have come under my notice lately. Going into a West End shop not many months ago, I was shown a prescription in which a physician had ordered morph. hydrochlor., gr. iij.; ext. hyoscyam., gr. ss., to be taken at bed-time. The blunder was apparent enough, but none the less a blunder. Only a few days ago my attention was called to another prescription, to which I must not now refer.

The number of accidental poisonings quoted by the Medical Officer of the Privy Council is very large, and, as he remarks, the actual number is probably larger. "A general practitioner," as Mr. Deane said, "may and does make numberless mistakes with impunity, because the facts are confined to himself and his own surgery." I could tell of a few, but I do not wish to throw stones. But there is one advantage which the general practitioner has over the chemist to which Mr. Deane did not allude—namely, that the former can sign certificates of death for his patients. Perhaps if druggists could do the same for their customers accidental poisonings would be somewhat fewer.

Moreover, the statement in the Government Officer's Report is likely to create a very false impression, since these "accidental poisonings" must necessarily include all the accidents in manufactories as well as such cases

as those related by Mr. Deane; and yet they are all thrown down at the door of the chemist and druggist. This is manifestly unfair, and I must ask your aid in exposing the unfairness. I am, &c.

A. CHEMIST AND DRUGGIST.

London, October 10.

A Query.

To the Editor of the CHEMICAL NEWS.

SIR,—Would you allow me, through the medium of your valuable paper, to ask the following question:—Iron wire, when under the influence of a sulphuric acid bath (or vitriol), diluted, is cleansed to a silvery brightness; but a portion of late coming under my notice, instead of leaving the bath bright as usual, came out with a dull black colour, and will not in consequence take the zinc bath, or what is more commonly called the galvanising bath. Some wire iron in the same bath came out with the proper colour—i.e., a silvery lustre. Now, if you or any of your numerous readers can tell me what the iron contains to cause the dull black colour, I shall ever feel grateful.—I am, &c.

AN OLD SUBSCRIBER.

MISCELLANEOUS.

New American Process for Separating Gold and Silver.—Mr. E. Balback, of Newark, U.S., proposes to melt the lead which contains the gold and silver in a furnace with an inclined hearth, and then to draw it off into a kettle containing a proper quantity of zinc to take up its silver and gold. After being sufficiently stirred for this to be effected, the mixture of lead, silver, gold, and zinc is cast into pigs and remelted in a furnace, with an inclined hearth, at a low heat, sufficient to cause the lead to melt and run off, but not sufficient to melt the zinc, silver, and gold.—*Mining and Smelting Mag.*

Bowditch's New Hydrocarbon Light.—A new method of carburetting coal gas, the invention of the Rev. W. R. Bowditch, was shown in London for the first time on Wednesday last. The method differs from all others hitherto in use, the inventor employing naphthalene and the heaviest hydrocarbons as the carburetting agents. These are placed in a gas-tight metallic box into which are soldered two gas-pipes, one for conveying gas into the box, and the other for conveying gas and vapour out of the box to the burner. The burner is fixed to the outlet pipe, and so placed that when gas is being burnt, the hot air from the gas flame must impinge upon the box. This box is provided with a screw-plug through which the hydrocarbon is put into it, and this plug is closed during use. The box being supplied with hydrocarbon, is connected with any ordinary gas-fitting, and the gas is lighted. At first, the gas passes over the surface of the hydrocarbon without being affected, but when the temperature has risen sufficiently to convert the hydrocarbon into vapour, the passing gas carries with it a quantity of the vapour, and the flame becomes highly illuminating, the illumination being proportional to the quantity of vapour present in the flame. As may be imagined, the increase of light is enormous, and from the experiments we witnessed we believe the following extract understates the results:—"In London, 1000 feet of gas costs 4s. 6d., and, as burnt in flat-flame burners, gives the light of 1500 candles. An addition to this of $4\frac{1}{2}$ lbs. of carbolene (as the inventor styles the oils employed) (costing about 9d.) raises its light to that of 7500 candles. In other words, 5000 feet of common gas give the light of 7500 candles, at a cost of 17s. 2s. 6d., whereas the same light may be obtained from 1000 feet of carburetted gas at a cost of 5s. 3d., being a saving of 17s. 3d. upon each 5000 feet of gas." The apparatus we should say is perfectly safe, and gives no trouble. A great advantage of the light is the perfect steadiness of the flame.

A Method of Dyeing Moss Green.—Before being employed for artificial flower making, or similar purposes, moss should be dyed green, and this is effected by the following process:—Boil about 2 litres of water, and pour into it 0.016 of picric acid, and a proper quantity of carmine indigo. Vary this quantity according to the shade of green desired, adding picric acid, to obtain a lighter tint. Tie the moss in small bundles, and plunge the upper part into the boiling dye for about a minute, then dry it.—*Moniteur Scientifique*, vi. 667, 64.

Lunar Scenery.—Mr. James Nasmyth contributes to the *Journal of Science* an article on the "Physical Aspects of the Moon's Surface," in which he thus describes one of the scenes that would present themselves to a terrestrial spectator if he were placed on the surface of the moon:—"Among the many terribly sublime scenes with which the moon's surface must abound, none can be grander than that which would present itself to the spectator, were he placed inside one of these vast volcanic craters (Tycho, for instance), surrounded on every side by the most terrific evidences of volcanic force in its wildest features. In such a position he would have before him, starting up from the vast plane below, a mighty obelisk-shaped mountain of some 9000 feet in height, casting its intense black shadow over the plateau; and partly up its slope he would see an amphitheatrical range of mountains beyond, which, in spite of their being about forty miles distant, would appear almost in his immediate proximity (owing to the absence of that 'aërial perspective' which in terrestrial scenery imparts a softened aspect to the distant object), so near, indeed, as to reveal every cleft and chasm to the naked eye! This strange commingling of near and distant objects, the inevitable visual consequence of the absence of atmosphere or water, must impart to lunar scenery a terrible aspect—a stern wildness, which may aptly be termed unearthly. And when we seek to picture to ourselves, in addition to the lineaments and conditions of the lunar landscape, the awful effect of an absolutely black firmament, in which every star, visible above the horizon, would shine with a steady brilliancy (all causes of scintillation or twinkling being absent, as these effects are due to the presence of variously heated strata or currents in our atmosphere), or of the vivid and glaring sunlight, with which we have nothing to compare in our subdued solar illumination, made more striking by the contrast of an intensely black sky; if, we say, we would picture to ourselves the wild and unearthly scene that would thus be presented to our gaze, we must search for it in the recollection of some fearful dream."

ANSWERS TO CORRESPONDENTS.

* * All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

* * In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

A. R.—Common salt is the best thing to use.

A. H. A.—The only edition was published in 1858 by Van Voorst.

W. J. M.—Letter has been sent. Dr. F. Grace Calvert's *Cantor Lectures* were published in Nos. 240—249.

Books Received.—Companion to the British Pharmacopœia. Second Edition.

Received.—C. Tomlinson; Messrs. Churchill; G. F. Rodwell; P. Squire.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Action of Sulphurous Acid on Sulphur,
by M. BERTHELOT.

ACCORDING to a recent observation of M. Geitner, pupil of M. Wöhler, a watery solution of sulphurous acid, heated to 200° , decomposes into sulphur and sulphuric acid.

On repeating this experiment, which was successful even between 160° and 180° (sixty-four hours of reaction*), I proposed to examine the nature of the sulphur produced. Treated by sulphide of carbon it separated into two parts, a soluble and crystallisable kernel, with an insoluble envelope, the weight of the envelope being much less than that of the kernel.

The formation, under these circumstances, of insoluble sulphur is deserving of attention, for it is formed under the influence of very slow cooling—from 160° to the ordinary temperature. Now, under these conditions, the soluble sulphur is entirely transformed into crystallisable sulphur. It is evident that one of the products in contact with the insoluble sulphur, water, sulphurous or sulphuric acid, has effected its preservation.

From the following experiments it would appear that sulphurous acid possesses this property:—

1. An aqueous solution of sulphurous acid heated to between 110° and 115° with octahedric sulphur during several hours, yielded a melted globule. After cooling it was found that the outer part of the globule was formed of insoluble sulphur, and the inner part of crystallisable sulphur.

2. Octahedric sulphur, heated with pure water, in the same conditions remained completely soluble in sulphide of carbon.

3. An aqueous solution of sulphurous acid, heated alone under the same conditions, undergoes no alteration.

4. Insoluble sulphur, extracted from flour of sulphur and heated with water to between 110° and 115° under similar conditions, melts and changes completely into crystallisable sulphur.

5. The same insoluble sulphur, heated under the same conditions to 110° or 115° with an aqueous solution of sulphurous acid, melts and furnishes a globule exactly like that of octahedric sulphur submitted to the same influences, the outer part being formed of an insoluble coating, the inner of crystallisable sulphur.

6. Octahedric sulphur kept fused between 115° and 120° for a quarter of an hour, under a bed of concentrated sulphuric acid, remains completely soluble.

From these facts it appears that sulphurous acid possesses a specific action for changing crystallisable into insoluble sulphur.

This action is the more remarkable as by melting and then quickly cooling crystallisable sulphur, no formation of insoluble sulphur takes place; at least, when heated above 150° or 160° , as I established long since by some experiments. There is a fixed term, below which not the slightest trace of insoluble sulphur is obtained by sudden cooling. Hence I infer that the molecular transformation of sulphur is not due to the tempering, that is to say, to the abrupt cooling, but to influences anterior to the cooling and independent of it. The abrupt cooling merely insures the permanence of a special state produced under the influence of heat before this cooling takes place.

Sulphurous acid, on the contrary, has a peculiar in-

fluence, as it determines the formation of a new molecular state which commences at the fusing temperature of sulphur. This property it shares with nitric acid, as I have elsewhere shown; but the action of sulphurous acid is simpler, it being accompanied by no oxidation or other accessory phenomenon.

I will add, that the formation of insoluble sulphur, under the influence of either sulphurous or nitric acid, seems to require the previous melting of the sulphur. In fact, octahedric sulphur, either heated to 100° for several hours, with an aqueous solution of sulphurous acid, or kept cold during several months, in contact with the same solution, undergoes no alteration. Furthermore, insoluble sulphur (from flour of sulphur) kept at 100° , in contact with an aqueous solution of sulphurous acid gradually changes into crystallisable sulphur, only the transformation is rather slower than with pure water.

I have endeavoured to increase the action of the sulphurous acid by employing this body either in the gaseous state or as anhydrous liquid. The gas between 115° and 120° produced nearly the same effect as its aqueous solution. It is the same with anhydrous and liquid sulphurous acid at the same temperature with this secondary circumstance, that the hot liquified sulphurous acid dissolves by heat a small quantity of sulphur, which during the cooling separates in prismatic crystals.

All these concurrent facts prove that the transformation is effected only by contact with sulphurous acid, which contact transforms the surface, without affecting the centre.

The vesicular structure of flour of sulphur, that is to say, of a variety of sulphur which solidifies in an atmosphere of sulphurous acid, seems to me to be explained partly by the speediness of the cooling, partly by the same cause which operates in the preceding experiments. The vesicle is, in fact, formed of insoluble sulphur enclosing soluble sulphur.

One more instance,—every time sulphur takes the solid state in a chemical reaction or otherwise, in presence of sulphurous acid, it contains a proportion more or less considerable of insoluble sulphur. When sulphur becomes soluble in presence of sulphuretted hydrogen, it is entirely soluble and crystallisable. These are experimental facts.—*Annales de Chimie et de Physique*, I., 392, 64.

On the Presence of Nickel in Metallic Lead,
by Dr. A. T. MACHATTIE, F.C.S., &c., Glasgow.*

HAVING had occasion recently to examine some specimens of lead for commercial purposes, I was surprised to find that one of them contained a considerable quantity of nickel; and as I am not aware that nickel is a commonly occurring impurity in lead, or, indeed, that it has been found in commercial lead before, I take this opportunity of recording the results of the analysis made by me of the sample in question.

The composition of the specimen analysed was as follows:—

Lead	82.75
Antimony	10.86
Nickel	5.20
Iron . . . . .	.86
Loss, including a trace of arsenic . . . . .	.33
	100.00

It will be observed that the above analysis represents

* Read at the meeting of the British Association at Bath.

* A solution containing twenty volumes of sulphurous acid is not completely decomposed under these conditions.

a highly impure specimen of lead, for besides the nickel, which gives to it its present interest, the sample contains nearly 11 per cent. of antimony. Such lead could scarcely be used for the ordinary applications of the metal, but the large percentage of antimony might probably recommend it for the manufacture of type metal.

The physical characters of the lead were such as to show, even without an analysis, that it was very impure. When trying to divide a portion with an iron chisel, the mass broke with a crystalline fracture, and was not cut like ordinary lead. The brittleness thus exhibited by this alloy is, no doubt, much more due to the antimony than to the nickel, but the latter probably assists in communicating this property to the metal. Again, the specific gravity of this lead is only 9.95, whilst that of pure lead is 11.4 (water = 1); but as nickel has a specific gravity of 8.8, and antimony of 6.8, the low density of the alloy is easily accounted for.

The source of the ore from which the metal was obtained I could not discover, further than that the lead is of German manufacture, which so far explains the presence of such a large proportion of nickel.

On the Dimorphism of Antimonious and Arsenious Acids, by M. H. DEBRAY.

ARSENIOUS and antimonious acids we know are isodimorphous; in fact, according to circumstances, they will crystallise in regular octahedral or in right rhomboidal prisms. I will briefly indicate how antimonious acid may be prepared in either of these forms.

By oxidising antimony at red heat, we obtain prismatic antimonious acid—argentine flowers of antimony (Sb_2O_3). By pouring a solution of protochloride of antimony (Sb_2Cl_3) in hydrochloric acid drop by drop into a boiling solution of carbonate of soda, the precipitate produced examined under the microscope is, according to Mitscherlich, composed entirely of prismatic crystals. The acid is obtained in octahedral crystals by dissolving hydrate of antimonious acid in a boiling solution of potash, and as the liquid cools small octahedrals are deposited. Mitscherlich has also prepared it in this form by adding hot water to a boiling solution of chloride of antimony in hydrochloric acid, until the moment the precipitate ceases to redissolve. The liquid on cooling gives more numerous crystals than are obtained by any other method. M. Pasteur has obtained octahedrals by the spontaneous transformation of humid oxychloride of antimony (powder of algaroth) into hydrochloric acid and oxide of antimony.

By decomposing algaroth powder by water at about 150° , I found that the matter was integrally transformed into prismatic lamellæ as voluminous as the argentine flowers obtained by the direct roasting of the metal.

This experiment, in addition with those preceding, sufficiently shows the influence of temperature on the crystalline form of antimonious acid, as this body, prepared cold, or at least below 100° , in alkaline or acid liquids, is always octahedral, while the acid obtained in alkaline or acid liquids above 100° , or by the action of heat alone, is always prismatic. I have endeavoured to ascertain whether the temperature of crystallisation influenced in the same way the form of arsenious acid.

As the crystals of arsenious acid obtained by crystallising this body in pure water or in hydrochloric or ammoniacal solutions at a moderate temperature are always octahedral, I heated a large quantity of this acid in a little water, in a closed vessel at about 250° . While cooling microscopic prismatic crystals were first produced,

then voluminous octahedrals. At this temperature water dissolved at least its weight of arsenious acid. However, by this process but a small amount of prismatic acid is produced, but it is obtained more easily and in sufficiently voluminous crystals in the following manner: Introduce arsenious acid (vitreous or octahedral) into a long glass tube, which then close by the lamp; place this tube vertically in the axis of a long earthen tube closed at one end by a stopper of luting clay, and fill the space between the tubes with sand. Place the earthen tube vertically on a gas furnace, and surround it with an earthen muff to prevent its cooling; then heat and keep the gas burning for eight or ten hours, and the lower part of the tube soon reaches the temperature of about 400° , but the temperature of the upper part does not at the end of the operation pass 200° . When the apparatus has cooled, vitreous arsenious acid is found at the bottom of the tube, in the middle part prisms visible to the naked eye, and in the upper part beautiful octahedrals without admixture of prisms. The arsenious acid vapours produced in the tube condense at various heights, giving octahedrals in the cold parts, and prisms in those where the temperature was above 200° . Later, when the apparatus has cooled, some octahedrals form in the middle of the tube, but they are evidently deposited on the prisms.

To M. Wöhler is due the discovery of prismatic arsenious acid; he found it in the products of sublimation obtained in the roasting of cobalt and nickel ores. The foregoing experiments seem to me to establish the precise conditions under which this acid is formed. Arsenious acid is generally deposited in octahedrals on the slightly heated sides of the condensing chamber; but if the temperature happen to become considerably elevated prismatic crystals are deposited.

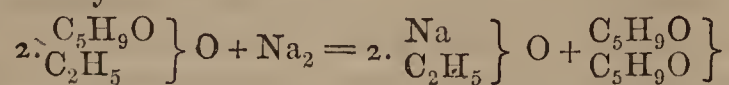
Prismatic arsenious acid had not been elsewhere produced except under the circumstances indicated by M. Pasteur. Arsenite of potash deposits while cooling, in the form of microscopic crystals, the arsenious acid which it dissolves when hot. This experiment shows that the temperature at which the crystallisation in prisms take place depends on the nature of the liquid, for towards 100° , with pure or acidulated water, only octahedral crystals are obtained, but temperature exerts nevertheless an incontestable and frequently predominant influence on the crystalline form. I have proved this, and have ascertained with regard to sulphur which, in sulphide of carbon, crystallises in prisms towards 100° , while at the ordinary temperature this liquid is instantaneously transformed into rhomboidal octahedrals.

Thus, for antimonious and arsenious acids, as for sulphur and carbonate of lime, there are two special stable molecular states at two different temperatures, and corresponding to two incompatible crystalline forms; but between antimonious and arsenious acids and carbonate of lime on the one hand, and sulphur on the other, there is an important difference. Prismatic sulphur prepared towards 110° is stable only at about this temperature, while the prisms of antimonious and arsenious acids and the rhombohedrals of carbonate of lime formed at a more or less elevated temperature are stable even at the ordinary temperature, though antimonious and arsenious acids and carbonate of lime thus formed are, the first octahedral, the second prismatic (arragonite).

But these bodies, like sulphur, can pass by the action of heat from the condition stable at the ordinary temperature, to the form produced by a higher temperature. —*Comptes Rendus*, lviii., 1209, 64.

Action of Sodium on Valerianic Ether,
by J. ALFRED WANKLYN.

WHEN sodium acts upon valerianic ether it displaces the acid-forming radical valeryl, and not the alcohol-forming radical ethyl.



The research will appear in detail in the next number of the Chemical Society's Journal.

London Institution, October 17.

Preliminary Notice on a New Earth,
by M. CH. BISCHOF.

IN treating a calcareous mineral by the ordinary reagents, M. Ch. Bischof has discovered an earthy substance which, by its chemical properties, appears to differ from all the other known earths. The following are the different characters assigned to it by the author:—

The new earth is precipitated by sulphide of ammonium; it is more completely precipitated by potash than by ammonia. The precipitate is bluish white, gelatinous, and dissolves sensibly in water. An addition of tartaric acid does not prevent it forming. It is almost completely soluble in carbonate of ammonia. This solution is precipitated by oxalic acid. When this precipitate is intimately mixed with carbon, and the mixture heated in a current of dry chlorine, the chloride of the new base is seen to volatilise; the sublimate obtained is more volatile than chloride of iron. But what characterises more particularly this substance is the manner its chloride comports itself at a high temperature. Heated strongly, the salt splits up into a portion which sublimes in form of a white deposit, and a portion which remains and which presents the characters of a base.

The blowpipe and spectroscope failed to give any decisive reactions. The volatility of the chloride, and the solubility of the oxide in water have prevented M. Ch. Bischof obtaining a large quantity of the earth in question, but he promises a further communication.—*Cosmos*, October 6, 1864.

On the Quantitative Separation of Cerium from Yttrium, Aluminium, Glucinum, Manganese, Iron, and Uranium,
by WALCOTT GIBBS, M.D., Rumford Professor in Harvard University.

THE relations of the three metallic oxides of the cerium group to sulphate of potash have long been familiar to chemists, and have furnished methods of separation from other oxides which are still in use. In examining this subject I have found that sulphate of soda possesses great advantages over sulphate of potash, the double sulphates of sodium, and the protoxides of cerium, lanthanum, and didymium, being absolutely insoluble in a saturated solution of sulphate of soda. On the other hand, the double sulphates of sodium and glucinum, aluminium, yttrium, protoxide of iron, and sesquioxide of uranium, are readily soluble in sulphate of soda, and may easily be washed out from the highly crystalline insoluble double sulphates of the cerium group. In the analysis of minerals in which cerium occurs with one or more of the other oxides, the following method may be employed with great advantages:—

The oxides are to be brought into the form of sulphates, dissolved in the smallest quantity of water, and a saturated solution of sulphate of soda added, together with a sufficient quantity of the dry sulphate in powder

to saturate the water of solution. It is most advantageous to use hot solutions. The insoluble double sulphates of soda and the cerium metals separate immediately, as a white, highly crystalline powder, which is to be brought upon a filter and thoroughly washed with a hot saturated solution of sulphate of soda. After washing, the double sulphates upon the filter are to be dissolved in hot dilute chlorhydric acid, the solution largely diluted with water, and the cerium metals precipitated by oxalate of ammonia, in the manner already pointed out. From the filtrate the oxides of the yttrium group may be precipitated at once by oxalate of ammonia, after peroxidising the iron by means of chlorine water, and rendering the solution slightly acid with chlorhydric or sulphuric acid. The only precaution to be taken in this process is to reduce the iron completely to the form of protosulphate before precipitating the cerium with sulphate of soda. This is best accomplished by means of a current of sulphhydric acid gas passed into the hot solution. The precipitated sulphates always contain iron when this precaution has been neglected. This iron is easily detected in the filtrate from the oxalates, and may be precipitated by ammonia, and added to that obtained from the main solution.—*American Journal of Science*, vol. xxxvii., p. 354.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, F.C.S.

(Continued from page 77.)

8. **Early Chemistry of the Air.**—From the title of these papers it would naturally be supposed that their object was to give a chemical history of the air, and such was the original intention; but from the fact that many of the experiments of the earlier philosophers are partly physical and partly chemical, and from other causes, I found it impossible to speak of the chemistry of the air alone. I have, therefore, thought it better to give what Mr. Boyle would have called a *physico-chemical* history of the air.

Pneumatics rose to the rank of a science long before chemistry—hence the physical properties of the air were studied before its chemical properties, and hence it follows that the preceding papers have treated of the former rather than of the latter. We have now to consider the early chemistry of the air.

The theory of the mutual convertibility of the four ancient elements was admitted from very early times; it was a tenet in the philosophy of Anaximenes of Miletus, in that of the Stoics, and in that of Aristotle; and it obtained almost universally, either as a whole or in part, till comparatively recent times; we find it admitted in all works on alchemy and chemistry, and in almost all physical treatises published before the 17th century.

As part and parcel of this theory it was believed that water was converted into air by the action of heat, and that air, when submitted to condensation and intense cold, became water.

Among the very few who denied this was Van Helmont,* who maintained that if air could be converted into water by condensation and cold it would assuredly become water in very cold weather when condensed in an air-gun; he adds, moreover, that water never becomes air because if we distil a known weight of water in an alembic we find the same weight in the receiver at the end of the operation, the water being “retorted or struck back” † into its own form again.

* Born 1577. Died 1644.

† Alembic is evidently a word of Arabic origin. Chemistry took its rise in Arabia, and the alembic was probably one of the earliest

Van Helmont was well aware of the evaporation of water at the ordinary temperature, and it was to distinguish this vapour from steam that he introduced the word *gas* into chemistry. "But because," he writes,† "the water which is brought into a vapour by cold is of another condition than a vapour raised by heat, therefore, by the license of a paradox, for want of a name, I have called that vapour *Gas*, being not far severed from the *chaos* of the ancients. In the meantime it is sufficient for me to know that gas is a far more subtle or fine thing than a vapour, mist, or distilled oiliness, although, as yet, it may be many times thicker than air. But gas itself, materially taken, is water as yet masked with the ferment of composed bodies."

I have invariably seen *gas* derived from the German *geist*: the derivation from *geist* is more plausible than that from *chaos*; nevertheless the latter, although obscure, is not, I conceive, unintelligible.§

Hesiod, who is supposed to have lived about 900 B.C., is said to have been the first to introduce the idea of the *χάος*, but it is probable that he borrowed it from Sanchoniatho, || the most ancient heathen writer.

The "chaos of the ancients" was conceived to be a confused mixture of elements, from which, when order and harmony were restored by the Creator, the universe was produced. Now, Van Helmont conceived that water is the primal element, from which everything but air and fire is evolved; all substances, animal, vegetable, and mineral, are produced from it and return to it; hence the vapour of water would be a confused mixture of the elements, or at all events a something from which all material substance could be produced, and inasmuch as this had hitherto received no name, he determined, from its resemblance to the ancient chaos, to call it *chaos*, which by an easy change becomes monosyllabic (*chas*), and then has almost the sound of *gas*.

From an early age, cupping glasses were caused to draw blood from a patient by placing fire within them to rarefy the air; according to Hero, of Alexandria, the fire "*consumes and rarefies*" the air within them, just in the same way that fire consumes and rarefies water and converts it into air. In the time of Francis Bacon, the experiment of burning a candle in a bell jar inverted over water was well known, Bacon denies that air is consumed by the flame, as some imagined; he explains the rise of water into the jar by supposing that as soon as the flame has been "suffocated by the close air," the

invented chemical vessels: the word *alembicus* frequently occurs in the Latin translation of the works of Geber, the first writer on chemistry. The *retort* is a modification of the alembic, and received its name from *retorqueo*, because the liquid which undergoes distillation is *turned back* from the gaseous condition into its original liquid form.

† "Oriatrike, or Physick Refined." Written by that most Learned, Famous, Profound, and Acute Philosopher and Chemical Physitian John Baptista Van Helmont, Toparch or Governor in Moredc, Royenborch, Oorschot, Pellines, &c. Rendered into English by J. C (John Chandler), sometime of M. H. Oxon. London. 1662.

§ In order that it may be seen that Mr. Chandler's translation has nothing to do with the obscurity of the sentence, I have given the original below from "Johannis Baptistæ Van Helmont Opera Omnia Francofurti," 1707, p. 69. "Progymnasma Meteori," par 29, in which the sentence stands as follows:—"Verum quia aqua in vaporem, per frigus delata, alterius sortis quam vapor per calorem suscitatus. Ideo paradoxo licentia in nominis egestate halitum illum *gas* vocavi non longè à chao veterum secretum. Sat mihi interim, sciri quod *gas* vapore, fuligine et stillatis oleo-sitatibus, longe sit subtilius, quamquam multoties aere adhuc densius. Materialiter vero ipsum *gas* aquam esse fermento concretorum larvatam adhuc." The author of the article on Van Helmont in the "Nouvelle Biographie Générale" writes as follows:—"Lenom de *gaz* ou *gas* (orthographe de Van Helmont) est dérivé par corruption de *gahst* (*geist*) qui signifie *esprit*. Suivant d'autres il dérivé de *chaos*, de *blas* (souffle), ou de *gaescht* (écume)."

|| For the account of the Phœnician cosmogony given by Sanchoniatho, see "Ancient Fragments of the Phœnician, Chaldaean, Egyptian, Tyrian, Indian, Persian, and other writers," &c., by J. P. Cory.

water rises to occupy the space previously occupied by the flame, in order to prevent the formation of a vacuum. Van Helmont also denied that air is consumed by fire; this arose from the fact of his failing to distinguish between a body capable of supporting combustion, and a combustible body; if air, he argues, is consumed by fire, the whole air would have been inflamed long ago by one single candle, and would have perished. Moreover, if air could be burnt it would become changed, and would cease to be an element, whereas we know it to be a body not compounded of parts, but simple and unalterable.

The calcination of metals was one of the principal operations practised by the alchemists and early chemists; in all their writings we find a prominent place given to a description of this process.

Massicot and minium (PbO and Pb_3O_4) were much used by the ancients. Klaproth found 10 per cent. of oxide of lead in a specimen of red glass from an Egyptian mummy case; and Davy, on analysing the dark-yellow colouring matter of a piece of stucco found in an ancient Roman ruin, proved it to consist of a mixture of minium and protoxide of lead.

Geber, who wrote in the eighth century, was the first to notice that the calx of lead possessed a different weight from that of the lead which produced it. He writes as follows:—"¶ Et licet non multum perfectioni approximet, ex eo tamen per nostrum artificium defacili argentum formamus, et non servat pondus proprium in transmutatione, sed mutatur in novum pondus. Et hoc totum in magisterio acquirit. Est etiam plumbum argenti examen in cinericio, ejus causas dicemus."

Cardanus** added to this fact by stating that the gain of weight amounted to one thirteenth†† the weight of the lead taken. . . . "nam plumbum," he writes,†† "cum in cerusam vertitur, ac uritur, tertia decima parte sui ponderis augetur."

The explanation which Cardanus gives of the cause of the increase of weight is perfectly unintelligible to us, but during the 16th century many theories quite as impossible were brought forward to account for physical phenomena. The lead, he says, during calcination "dies," the celestial heat which gave it life, and rendered it light, is dissipated, and it consequently becomes heavier; just as animals after death become heavier than before, because their celestial heat has vanished.

Cæsulpinus§§ states that lead gains from 8 to 10 per cent. during calcination. "Peculiare huic," he writes,||| "quod derelictum fertilius reviviscit, crescit enim imbris; unde chemistæ argumentum sumunt, etiam aurum, et argentum augeri posse. Sed illud magis admiratione dignum est, quod ustum in fornace donec cinis fiat, crescit ejus pondus octo aut decem pro singulis centenariis, ut metallici testantur."

Cæsulpinus attributed the increase of weight to the presence of soot, which he conceived struck against the dome of the furnace in which the calcination was effected, and being beaten back, fell into the crucible.

¶ "Gebiri Philosophi ac Alchemistæ Maximi de Alchemia." 1531. Cap. 35. "Sermo in Saturno." Translated into Latin from the original Arabic.

** Born 1501. Died 1576.

†† 100 parts of lead require 7·173 of oxygen for transformation into PbO ; and 9·343 of oxygen for transformation into Pb_3O_4 .

†† "Hieronymi Cardani Medici Mediolanensis. De Subtilitate." Libri xxi. Parisiis 1551. Book v. "De mixtione et mixtis imperfectis, sen metallicis."

§§ Born 1519. Died 1603.

||| "De metallicis libri tres: Andrea Cæsulpino auctore." Ad sanctissimum dominum nostrum, Clementem viii. Pont. Max. Romæ. Ex. typographia Aloysii Zannetti, 1596. Lib. 3, cap. 7.

TECHNICAL CHEMISTRY.

On Pyroxylin, by MM. PELOUZE and MAUREY.

THE attempts made during the last twenty years to substitute gun-cotton for ordinary powder for fire-arms and mines have resulted in most opposite conclusions. In France, after numerous experiments, it has been discarded on account of its detrimental effect on the metal of fire-arms and accidents from spontaneous combustion and explosion, first brought into notice by a memoir presented by us to the Institute in 1849.

In Austria, General Lenk has continued to occupy himself with the manufacture and use of this explosive material. He prepares it by a process which has been followed on a large scale at Hirtenberg, and which remained for some years a profound secret. But during the last year papers on this subject have been published by German chemists and by General Lenk himself.

It would appear from these papers that the Hirtenberg pyroxylin does not decompose spontaneously, like that made in France at the Bouchet powder factory, and, moreover, differs from the latter in its composition and in the circumstance that its explosive power may be regulated by particular arrangements. We will now examine the value of these assertions, giving the results of some experiments and analyses we have made with the co-operation of MM. Faucher and Chapoteaut.

Processes followed at Hirtenberg and at Bouchet.—The pyroxylin made at Hirtenberg by General Lenk's process is, like the Bouchet pyroxylin, the product of the immersion of cotton in a mixture of monohydrated nitric acid and sulphuric acid at 66°. The two methods, however, differ in several respects.

Thus, the proportions of the two acids are not exactly the same, Lenk's mixture being composed of one part of nitric acid to three of sulphuric acid; that of Bouchet, under the name of unequal volumes, is prepared with one part of the first of these acids and two of the second, equivalent in weight to 1 per 2.46. The above-mentioned memoir gives as being most successful a mixture of three volumes of nitric acid and seven of sulphuric acid (by weight 1 to 2.86), proportions very nearly those given by General Lenk.

At Hirtenberg the cotton is steeped in portions of 100 grammes in 30 kilogrammes of the mixture. It is withdrawn from the bath after being shaken in it for an instant, and each time the quantity of mixture absorbed by the cotton is replaced by a fresh amount. These operations are continued indefinitely, the weight of the mixture being always 300 times that of the cotton.

When the desired quantity of cotton has been steeped, it is put into a receiver and allowed to remain forty-eight hours impregnated by the acids. It is then placed in a strainer, where most of the uncombined acids are expelled in a few minutes.

It is freed from the remainder in a stream of water in which it is washed, and where it remains immersed for six weeks, when it is strained a second time, boiled for two or three minutes in a solution of carbonate of potash of 2° Baumé. After a third and last straining the cotton is dried in the air if the weather is favourable; if not, in a stove of which the temperature is not allowed to exceed 20° C.

General Lenk has latterly made use of a solution of soluble glass of 12° Baumé. The cotton prepared as above is soaked in it, dried, and exposed to the air for a sufficient time to allow the carbonic acid of the atmosphere to combine with the soda of the glass, which determines

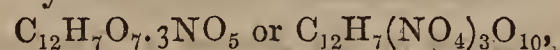
the precipitation of an insoluble silicate, which, according to General Lenk, "encloses the fibres of the cotton, and prevents the development of gases."

At Bouchet the cotton is steeped in vessels containing only 2 litres of mixture for 200 grammes of cotton, and the steeping is considered complete at the end of an hour.

About 70 per cent. of non-combined acids are pressed out, the cotton being then washed for one or two hours in the river, freed from most of the water by strong pressure, and left for twenty-four hours in an alkaline ley to neutralise the last traces of acids. Withdrawn from this, it is a second time washed in the river, then pressed, and finally dried on a light canvas, through which a ventilator forces cold air.

Soluble glass has not been tried at Bouchet; but we are about to show that it is not so beneficial as it is supposed to be by General Lenk.

Quantity of Pyroxylin produced by a given quantity of Cellulose.—A German report signed by MM. Redtenbacher, Schrötter, and Schneider gives to Lenk's pyroxylin the formula—



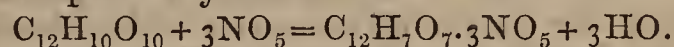
equivalent to the following composition:—

Carbon	24.24
Hydrogen	2.36
Oxygen	59.26
Nitrogen	14.14

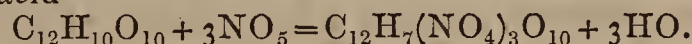
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The reaction may be explained in two ways:—

1. By admitting that by contact with the mixture of nitric and sulphuric acids the cotton loses the water, which is replaced by the first of these acids—



2. By supposing that the hydrogen of the cellulose is replaced by an equal number of equivalents of hyp-nitric acid—



According to this 100 parts of cotton ought to produce 183 of pyroxylin; but though in more than 100 experiments we have varied the proportions of the bodies producing this explosive matter, 178 is the greatest yield we have been able to obtain.

The German report is silent on the subject of the yield, which, in our opinion, constitutes the most solid basis for determining the composition of pyroxylin. We do not say that the exact determination of the yield of cotton in pyroxylin renders useless the elementary analysis of the latter, but it is necessary that the analysis should agree with the figures representing this yield.

Our experiments on the yields have been made with cotton of good quality, previously washed in a boiling solution of carbonate of potash or soap, and then freed as much as possible from foreign bodies, particularly from cotton seeds. Before being used it was carefully dried in a Gay-Lussac stove, between 100° and 115°.

The sulphuric acid marked 66° on the Baumé areometer. The nitric acid had a density of 1.500 at 9°; it was yellow and slightly nitrous.

The relative proportions of the sulphuric and nitric acids were varied so as to present—1. The composition of Lenk's mixture; 2. That of the unequal volumes of Bouchet; 3. Various intermediary proportions between 2 and 3 of sulphuric acid for 1 of nitric acid.

The relative proportions of acid mixture and the weight of cotton were also varied, including those formerly used at Bouchet, and those indicated by General Lenk, until the weight of the acids was 500 times that of the cotton.

The duration of the immersion of the cotton in the acids varied from 1 to 66 hours.

In all these experiments the yields differed very little, never exceeding 178 per cent. of cotton.

The yield in manufactories whether at Hirtenberg or Bouchet is far from being so large as that obtained with small quantities in the laboratory. In fact, General Lenk says that it requires 64·500 kils. of undried cotton to produce 100 kilogrammes of pyroxylin, which corresponds to a yield of 155. Supposing the cotton to contain 6 or 7 per cent. of moisture, the yield of dry cotton at Hirtenberg would have been from 165 to 167 per cent.

The yield at Bouchet, after the working had become regular, was 165·25 per cent.

Though unable to draw from these numbers any conclusion as to the theory of the formation of pyroxylin, we cannot pass over in silence a circumstance as important as the yield, so to speak identical with it, obtained on a large scale in the two factories.

(To be continued.)

On the Frescoes in the Houses of Parliament,
by Mr. W. P. KING.*

THE author has lived on the Durdham Down limestone, and has had the opportunity of observing the walls of buildings built with mortar made with the stone, which has been used in the plaster upon which the frescoes have been painted. He has thus often seen the efflorescences of sulphate of soda such as are seen on the walls of the Houses of Parliament, and therefore predicts the early destruction of the frescoes if especial care be not taken to preserve them. The rationale of the destructive process and the preventative means which should be adopted he described as follows:—When the weather becomes dry, all these bunches of crystalline efflorescence are converted into a loose white powder, much of which drops from the wall, carrying with it shales of plaster, or flakes of paint, or films of whatever material the surface of the wall is covered with. Moisture will condense on the wall, if allowed to grow cold, in damp weather; the white powder is then dissolved, and the liquor, a solution of sulphate of soda, is absorbed by the mortar or plaster. Architects are in the habit of proving the value of the various kinds of stone presented for their use for the endurance of frost by a saturated solution of sulphate of soda, similar to this liquor, which on crystallising imitates the heaving and splitting action of ice forming from water. This liquor is no sooner absorbed, as the wall dries, than it aggregates into ice-like crystals, and the plaster is disintegrated and heaved by the dynamical force developed in their formation. The plaster having sustained this injury, the salt transforms itself, and shoots out into bunches of needle-form crystals, only to fall again into the terrible white powder as the air becomes warm and dry. Thus a constant succession goes on of solution and desiccation with the changes of the weather and temperature, and if the wall be permitted to cool with the frost the ruin of the plaster is insured. Sulphate of soda exists not only in Durdham Down limestone, but unfortunately also in much abundance in all the lias mortars, in London clays, and in many other stones. In fact, the author doubted if any London wall was free from its presence. We may, therefore, observe this kind of action of destruction going on more or less almost everywhere. A marked instance of its injurious effect can be seen in the Crystal

Palace, where not only the surface of the richly-decorated walls is attacked, but also the plaster-cast statuary suffers, and requires constant renovation. In Rome and Florence, indeed, many frescoes have remained entire, with their colours smooth and in good order, for hundreds of years; but then these frescoes are on plaster made from travertino, a limestone of fresh water formation, free from salt, and the lime has been burnt with wood charcoal, in which there is no sulphur. In a late view which he had of the admirable fresco which Mr. Herbert has just finished, he found that the robing-room in the House of Lords was kept with a wet floor. If this apartment be ever allowed to grow cold, can we doubt that the fate of this glorious work of art is sealed? Damp will condense in drops on its surface and be absorbed. These drops will dissolve whatever trace of sulphate of soda exists in the plaster, or perhaps in the mortar of the wall. The salt will aggregate together (probably by the force of dialysis), then form ice-like crystals, to heave the plaster and show itself in a bloom on the surface of the fresco, and then dessicate into a dry powder, to be re-dissolved by the first moisture which comes over it, and then be re-absorbed again till at last it aggregates into blotches, and the destruction be complete. To preserve this fresco he recommended that the robing-room be kept always warm and as dry as possible, so that the sulphate of soda may not pass into solution and aggregation; and surely such a work of art, of which the nation is so justly proud, is worth the cost of any expense incurred in its preservation. The "liquid glass process," he understood, had been tried to secure the preservation of Mr. Herbert's fresco, but he doubted its power to prevent the plaster absorbing any drops of moisture which may come on its surface. Indeed, if there be any soda in the preparation of liquid glass it may accelerate the work of destruction, for carbonate of soda is almost as efflorescent a salt as sulphate of soda, into which, however, the former is often converted by the sulphurous acid gas seldom absent from London air. The author concluded that fresco painting on fresh-water limestone walls, kept constantly warm and dry, will have the best chance of endurance for ages yet to come, for the delight of our remote successors.

Preparation of Blue Ink with Prussian Blue, by
M. A. VOGEL.

PRUSSIAN blue dissolves in oxalic acid, giving a dark blue limpid liquid. This interesting discovery of MM. Stephen and Rasch, patented in England in 1837, is of great interest in tinctorial chemistry, as by its means Prussian blue may be very simply used in the form of a solution. To dissolve commercial Prussian blue in oxalic acid, first mix the blue with concentrated hydrochloric or sulphuric acid, then add an equal weight of water, leave to digest for forty-eight hours, then carefully extract all the acid by repeated washings. This process being minute and tedious, it is better to employ recently precipitated Prussian blue, which does not need the previous treatment by a concentrated acid.

By the following process the author has always obtained a good solid blue ink with Prussian blue and oxalic acid:—

Dissolve in a matrass, in a large quantity of water, ten grammes of sulphate of protoxide of iron; boil, and then add sufficient nitric acid to sesquioxidise all the iron. Then add a solution of yellow prussiate of potash containing ten grammes of this salt and leave the precipitate to

* Abstract of paper read at the British Association.

deposit. After decanting the supernatant liquid, throw the deposit on a filter, wash with cold water, and leave it to drain until it can be easily raised from the filter with a knife; then, without further drying, mix it in a porcelain mortar with two grammes of oxalic acid in crystals. Let the reaction continue for an hour, then gradually add 400 cubic centimetres of water. A dark blue solution is thus obtained, in which even after long standing no precipitate is to be found. This blue ink will not bear the least addition of black gall-nut ink; it is even advisable not to use a pen retaining a particle of this black ink.—*Moniteur Scientifique*, vi. 666, 64.

PHARMACY, TOXICOLOGY, &c.

On the Application of Dialysis in Determining the Nature of the Crystalline Constituents of Plants, by J. ATTFIELD, Ph. D., F.C.S., Director of the Laboratories of the Pharmaceutical Society of Great Britain*.

THE author had dialysed a few plant juices, the first that came to hand, and from each had obtained some of the crystalline constituents. The tops of the common potato yielded a crop of nitrate of potash, some cubes of chloride of potassium, hexagonal crystals not analysed, sugar, and an ammonia salt. The deadly nightshade gave nitrate of potash, an unknown magnesia salt in square prisms, sugar, &c. Pea-pods yielded only sugar. The common garden lettuce contained nitrate of potash, tetrahedra of undetermined composition, sugar, and ammonia. Cucumbers furnished sugar, ammonia, and sulphate of lime. The cabbage also furnished sulphate of lime and ammonia. Stramonium contained so much nitrate of potash, that dried portions quite deflagrated on being ignited.

From these experiments the author thought the proposed application of dialysis promised to be of great service, directly and indirectly, in investigating vegetable physiology.

In reply to Mr. Groves, who inquired if any of the alkaloids had been detected, the author said that traces of crystalline principles which were not referred to any particular substance were seen, and these possibly were natural salts of the alkaloids. Much larger quantities of material would be needed for their discrimination, and even then the relatively large amount of the colloid as compared with the alkaloid would make the complete isolation of the latter a doubtful problem.

Dr. Edwards was disappointed in the results of the application of dialysis to toxicology, from which much had been expected. If the process was continued for a length of time, portions of the colloid were transmitted through the membrane, and vitiated the result.

Mr. Brough observed that such a condition was inevitable, since there was no absolute line of demarcation in the transfusion of colloids and crystalloids.

PHOTOGRAPHY.

On Perchloride of Copper, by M. RENAULT.

WHEN copper is plunged into bichloride of copper, perchloride of iron, diluted *aqua regia*, a mixture of bichromate of potash and hydrochloric acid, chlorate of potash and diluted hydrochloric acid, or, indeed, into any liquid capable of abandoning chlorine more or less

easily, it becomes covered with a greyish white coating, which turns white on contact with cyanoferride of potassium, and afterwards red-brown. Air and water change the colour to yellow; and then the liquid gradually turns to blue. Solution of hydrate of potash, as well as alkaline carbonates, colour it yellow; carbonate of ammonia has the same effect as ammonia, which dissolves and colours it blue. This coating is soluble in hyposulphite of soda, cyanide of potassium, solution of iodine, in iodide of potassium, more or less dilute hydrochloric acid, sulphate of ammonia, &c. Diluted nitric and sulphuric acids do not sensibly alter it, at least when they are not too long in contact.

The most remarkable property of the cuprous chloride thus obtained is the facility with which it alters when exposed to sunlight; its greyish white colour gradually deepens to black, and assumes metallic copper reflections similar to those seen on the fractured surface of prussian blue or indigo. This property made me suppose that it could be used to obtain daguerreotype proofs, and the result showed the correctness of my opinion. A negative placed on a copper plate rendered sensitive by bichloride of copper gave a remarkably fine positive.

When the coating of chloride is sufficiently thin, the redness of the copper seen through the transparent light parts, gives a more agreeable tone than is possessed by the old daguerreotype pictures.

The solvents of the chloride altered by the sun—at least those above mentioned—are the same as those of unaltered protochloride.

The protochloride rapidly dried, sheltered from sun and air, preserves its original whiteness; if in this state exposed to the sun, it takes a very slight yellow tinge. The protochloride used in these experiments had been precipitated from its hydrochloric solution.

If dry white crystalline protochloride is spread on paper and exposed to the sun; and if the same is done with protochloride fused in a platinum vessel and then pulverised, no alteration takes place so long as the dry condition is maintained; but on the addition of a few drops of water each portion of the moistened protochloride paper assumes successively the before-mentioned yellow, grey, black, and violet tints. If the humid state is prolonged, a blue colour is obtained, due to the formation of bichloride.

A sensitive copper plate exposed to the sun and then quickly washed, imparted, with cyanoferride of potassium, no sensible colour to the water.—*Comptes-Rendus*, lix., 329. 64.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, October 5.

Mr. SANDFORD, President, in the Chair.

(Continued from page 188.)

DR. ATTFIELD's paper was entitled "*A Contribution to the History of Balsam of Peru*." The history of the balsam of Peru, he said, was still incomplete. Pereira has given precise information as to the localities in which the tree which yields it is found, and the method by which it is extracted; and others have given the testimony of eye witnesses as to the process by which it is collected. Mr. Hanbury has also gathered some historical particulars which has made our knowledge of it more exact. The process which is followed in the State of Salvador is simply this:—The bark of the tree is first loosened by beating it with a mallet; fire is then applied, which

* Read at the meeting of the Pharmaceutical Conference.

causes the bark to drop, and the balsam now exudes from the bared wood of the trunk. The fluid resin is then collected by wrapping rags round the tree, which, when saturated with balsam, are removed and boiled in water to separate the balsam. The chemistry of the balsam has been studied by Frémy, who found it to be composed of volatile oil, cinnamic acid, and a resin. The state in which the balsam exists in the tree, and the extent to which it may be altered by the process for extraction and exposure, are still unknown. In the hope of learning something about this, Dr. Attfield examined a small branch of the *Myroxylon Pereiræ*, kindly given by Mr. Hanbury, and also a portion of the trunk of the tree from the museum of the Society. The branch was young, and had no heart-wood; the trunk had dark coloured heart-wood nine inches thick, and bark about a quarter of an inch thick. The bark, white wood, and heart were finely rasped and examined separately. In imitation of the process actually adopted, heat was first applied very gradually to a portion of each specimen, but no exudation of balsam took place in either case, nor was any smell of balsam given off. On carrying the heat far enough for destructive distillation to take place, only acid water and tar were obtained. The samples were next boiled in ether, in which the ordinary balsam is soluble. The ethereal solutions obtained left, however, on evaporation, only a soft, brownish resin, which had no smell of balsam of Peru. These resinous products, when heated with water, evolved an odour which did not in the least resemble that evolved from balsam of Peru under similar treatment; nor had the water any acid reaction, as water warmed with the balsam always has. Dr. Attfield further proved the absence of cinnamic acid in the products, by endeavouring to form a soda salt, and afterwards decomposing it with hydrochloric acid, but no cinnamic acid could be obtained in this way. Lastly, he examined the ethereal residua for the resin of balsam of Peru, by treating each of them with concentrated sulphuric acid. This gives, with the balsams of Peru and Tolu, a persistent dark purple colour, but no colouration was produced with either of the residua. It is thus seen that the balsam of Peru tree contains an oily resin, which is either perfectly distinct from balsam of Peru, or a product of the alteration of the balsam, in which no trace of the constituents of the balsam remains. We must therefore remain in ignorance of the true nature of the balsam and the alteration it undergoes in the charring process, until fresh samples of the bark, wood, and balsam, obtained at the season of collection, can be examined. It would be interesting to know whether a balsamic resin could be procured without charring the bark, or by making deep incisions in the trunk of the tree. The charring appears to be a custom of Indian origin, for it is asserted that the Spaniards obtained the resin without heat. The resin which exudes from the tree spontaneously, Dr. Attfield has shown in a former paper, is not balsamic.

After a few remarks by Mr. Hanbury, the meeting was adjourned until Wednesday, November 2, at which meeting Professor Bentley announced that Dr. Daniell would exhibit a specimen of hydrocyanic acid obtained from the Cassava plant.

LECTURES ON CHEMICAL PHILOSOPHY.—V.

Delivered at the College of France, by M. A. WURTZ.

(Continued from page 91.)

Theory of Substitutions.

ON January 13, 1834, M. Dumas presented to the Academy of Sciences a memoir, in which he enunciated the following proposition:—

“Chlorine has the singular power of substituting itself for hydrogen, atom for atom.”

This simple statement was of great importance. Develop-

ing the idea somewhat further a little later, Dumas formulated the law of substitutions in the following terms:—

“1. When a hydrogenated body is submitted to the action of chlorine, bromine, iodine, oxygen, &c., for every atom of hydrogen which it loses it gains an atom of chlorine, bromine, iodine, oxygen, &c.

“2. When the hydrogenated body contains oxygen, the same rule applies without modification.

“3. When the hydrogenated body contains water, this loses its hydrogen without anything replacing it; but starting from this point any new atom of hydrogen removed is replaced as in the preceding cases.”

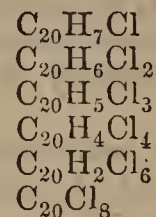
These propositions were founded upon a certain number of facts. Thus Gay Lussac had observed that wax submitted to the action of chlorine lost hydrogen and acquired an equal volume of chlorine. Dumas himself had proved an analogous substitution in the case of naphthaline.

But the discovery which was the immediate occasion of the enunciation of the law of substitutions was that of *chloral*. Chloral is the product of the action of chlorine upon alcohol C_2H_6O : its formula is C_2H_3ClO .

To say the truth, chloral is not a substitution product of alcohol: it is derived from the hydrogenated body C_2H_4O (aldehyde). When chlorine acts upon alcohol, two atoms of hydrogen are removed without any substitution taking place. Thus it is worthy of remark that the author of the law of substitutions had fortuitously met with an exception to this law—an exception which, according to the second proposition indicated above, ought to follow the rule.

Among the labours which have most contributed to confirm the theory of substitutions we must quote the experiments of Laurent on naphthaline.

The action of chlorine upon naphthaline is complex. Chlorine first fixes itself upon naphthaline, and then substitutes itself for hydrogen. We shall now only consider the cases of substitution. Laurent, starting from the primordial compound $C_{20}H_8$,* succeeded in forming the following series:—



Dumas had enunciated an empirical law, a simple relation between the chlorine which enters into and the hydrogen which is withdrawn from the compound. Laurent saw much further into the phenomena, and he maintained that chlorine not only took the place of, but played exactly the same part as hydrogen.

Dumas and Laurent compared molecules to edifices: if you remove a stone from a building it must be replaced, or the building falls down. So if you remove one or several atoms from a molecule, the empty spaces must be filled with other molecules. It is clear, therefore, that the new atoms must take the places of the old, and, up to a certain point, play the same part. In this sense the proposition is as evident as indisputable, but Laurent and Dumas intended to give it a much greater extension. They believed that the fundamental properties of a substitutional derivative ought to be identical with those of the original compound.

The similarity of the properties of ordinary acetic acid— $C_2H_4O_2$ —and those of trichloroacetic acid— $C_2HCl_3O_2$ —supported their view. Later, however, it became necessary to give up the idea when chemists discovered the dissimilarity between cinchonine and its chlorine derivatives by substitution. Cinchonine is a base, while the chlorine derivatives lose the basic character, and end by becoming indifferent. A similar remark applies to the chlorine derivatives of aniline, and Gerhardt still later described ammoniacal acids.

* The author here again adopts the old notation.

The first true extension of the theory of substitutions is due to Laurent. He regarded chemical combinations as containing two kinds of radicals: *fundamental radicals* and *derivative radicals*. Thus, alcohol and ethers all contained, according to him, the fundamental radical or *nucleus* etherine C_4H_4 . Add to this radical HO , you have ether C_4H_4HO ; add $2HO$, and you have alcohol $C_4H_4H_2O_2$; add O_4 , and you have acetic acid $C_4H_4O_4$; add Cl_2 , and you have Dutch liquid $C_4H_4Cl_2$.

But in the compound C_4H_4 you may replace H_2 by O_2 , and thus form a new radical $C_4H_2O_2$, which, united with O_6 , forms oxalic acid $C_4H_2O_8$. In the same compound, C_4H_4 , H_3 may be replaced by Cl_3 to form C_4HCl_3 , which, united with O_4 , forms trichloroacetic acid $C_4HCl_3O_4$, and, with O_2 , forms chloral. In this way we have the following series:—

C_4H_4 etherine.
 C_4H_4HO ether.
 $C_4H_4, 2HO$ alcohol.
 $C_4H_4O_2, O_6$ oxalic acid.
 C_4HCl_3 .
 C_4HCl_3, O_2 chloral.
 C_4HCl_3, O_4 chloroacetic acid.

In the theory of Laurent, $C_4H_2O_2$ and C_4HCl_3 figure as derived radicals.

The theory of nuclei, although it has been adopted by Gmelin in his celebrated "Handbook," has never done great service to science, but it offers the first example of a general theory of organic compounds founded upon a fusion of the theory of radicals with that of substitutions.

Next to the works of Laurent we must notice, as having exercised a notable influence on the development of the theory of substitutions, the researches of Regnault on the chlorinated derivation of Dutch liquid and hydrochloric ether. Starting from hydrochloric ether C_4H_5Cl (equivalents), Regnault effected the following substitutions:—

$C_4H_4Cl_2$
 $C_4H_3Cl_3$
 $C_4H_2Cl_4$
 C_4HCl_5
 C_4Cl_6

Parallel with the foregoing he succeeded with another series having Dutch liquid for its starting point:—

$C_4H_4Cl_2$
 $C_4(H_3Cl)Cl_2$
 $C_4(H_2Cl_2)Cl_2$
 $C_4(H_3Cl_2)Cl_2$
 $C_4Cl_4Cl_2$

The corresponding terms of each of these two series are isomeric, except the last term of the one, which is identical with the last term of the other.

The beautiful experiments of Malaguti on the chlorinated derivations of compound ethers brought a considerable tribute to support the theory of substitutions. We must notice still another important development of the theory, the discoveries of Dumas, relating to the substitution of the group (NO_4) for hydrogen in the compounds called nitrogenised. This was the first instance of the substitution of a group or compound radical for an element, and we know what an extension facts of this kind have given to the theory of substitutions.

Berzelius combatted the theory, and opposed himself to such a natural interpretation of the facts we have mentioned. For each new discovery which seemed to support the theory of substitutions he invented a new hypothesis intended to place the facts in accordance with his preconceived ideas. He invented radicals with inexhaustible fertility, and attributed to the most simple chlorinated compounds formulæ often very complex, but in accordance with his dualistic notions. His efforts have remained sterile, and the resources of his powerful mind exhausted themselves in the ungrateful labour. He made only a semblance of concession a short time before his death by admitting that the substitution of chlorine for hydrogen

was possible in radicals, and thus his powerful opposition delayed, but could not prevent, the definite triumph of the theory of substitutions.

We have arrived at the end of our historical *exposé*, and will now consider the facts of substitution and endeavour to penetrate the true sense of the phenomena.

(To be continued.)

ACADEMY OF SCIENCES.

October 10.

M. CARUS forwarded an observation he had made on the phosphorescent matter of the *Lampyris italica*. This, when removed from the insect, is an unctuous matter, somewhat resembling melted phosphorus in appearance. When dried on a glass plate, it exhibits no luminosity, but when moistened with water, the phosphorescence returns.

M. Caron continues the apparently interminable discussion on the action of carbonic oxide on iron. He contends, in opposition to M. Margueritte, that carbonic oxide has little or no action on iron.

M. Berthelot presented a memoir on the synthesis of formic acid. The author, as our readers know, discovered that formic acid is produced by direct synthesis, when carbonic oxide is maintained for some time in contact with caustic potash. He is at a loss to account for this, since the combustion of an equivalent of the acid produces much more heat than that of an equivalent of carbonic oxide. He considers that something more than the ordinary action of affinity is required to explain the production of the acid under these circumstances, and seems to regard it as the result of something analagous to vital force. A new fact now pointed out is that light has no influence on the combination, the change apparently taking place more rapidly in complete darkness.

M. Bechamp contributed a note on the origin of wine ferments. The author shows (1) that the presence of air is necessary neither for the development of the ferment nor the commencement of the vinous fermentation, and that the grape brings everything necessary for the perfect accomplishment of all the phenomena; (2) that the surface of the grape may carry the sporules and globules of the ferment; (3) that the stalks and leaves of the vine may carry the same organisms on their spores, which may, in fact, be met with on various parts of other vegetables. The author found, by experiment, that he could set up fermentation in a solution of sugar, by introducing grape stalks and vine leaves, and also by the petals of the red poppy. A microscopic examination of the waxy matter on a ripe grape, he says, reveals the presence of organised bodies identical with those produced in fermentation.

M. Pisani forwarded an analysis of a mineral found in the killas of Cornwall, and named by Professor Maskelyne langite. It contains—

Sulphuric acid	...	...	...	16.77
Oxide of copper	...	...	...	65.92
Lime	...	...	...	0.83
Magnesia	...	...	...	0.29
Water	...	...	...	16.19

100.00

Which corresponds with the formula $(Cu)_4S + 4H$. This mineral differs from brochantite only by containing an atom more water.

Preservation of Silkworms.—M. Onesti has found that wood-soot, if sprinkled over silkworms attacked with *fébrine*, effects an almost certain cure, or, at all events, prolongs their lives until the cocoons are finished. The French Minister of Agriculture has addressed a circular to the *préfets* of the sericultural departments of France, and has requested that a commission be formed to report on the value of M. Onesti's discovery.—*Chronicles of Zoology*, "Quarterly Journal of Science."

NOTICES OF BOOKS.

Zeitschrift für Chemie und Pharmacie, &c. Heft 19.
October, 1864.

THE original papers in this number of Dr. Erlenmeyer's journal are very short. The first is "*On the Transformation of Helicin into Salicin*." This is effected by the action of an excess of sodium amalgam on an aqueous solution of helicin. The solution obtained is saturated with carbonic acid, evaporated to dryness, and the salicin extracted from the residue by boiling alcohol. It has all the properties of ordinary salicin. Lissenko publishes "*A Contribution to the History of Zinc Ethyl*." When anhydrous alcohol is poured upon zinc ethyl a gas is obtained which the author found to be a mixture of hydride of ethyl with 14 per cent. of air. A white, insoluble mass remained in the flask, which Lissenko at first considered to be $\left\{ \begin{matrix} \text{Zn}'' \\ (\text{C}_2\text{H}_5)_2 \end{matrix} \right\} \ominus_2$, but which Butlerow has since proved to be $\left\{ \begin{matrix} [\text{Zn}(\text{C}_2\text{H}_5)]' \\ \text{C}_2\text{H}_5 \end{matrix} \right\} \ominus$, or which at least contains a large admixture of this body. The existence of this body he considers to prove the biatomicity of zinc.

The extracted papers include some from the *Comptes Rendus of the Academy of Sciences* which we have noticed before, and also papers by Fritsche, "*On the Artificial Formation of Gay-Lussite*," and "*On Double Salts of Oxalate of Lime and Chloride of Calcium*." The other papers require no notice.

Annales de Chemie et de Physique. August, 1864.

THIS journal opens with an interesting and important paper by M. Victor de Luynes, entitled "*Researches on Erythrite and its Derivatives*." It is prefaced by an introduction on alcohols in general, which merits a full translation. The author regards erythrite as a tetra-atomic alcohol of the butylic series. In the course of his experiments he discovered a means of obtaining butylene in a state of purity, and so is enabled to give a more complete account of this body than has hitherto been given. Erythrite treated with fuming hydriodic acid yields, on distillation, hydriodate of butylene, and this decomposed with acetate of silver furnishes pure butylene, which may be condensed into a liquid by means of a freezing mixture. The author further describes the acetate and hydrate of butylene, and concludes with a section on the part which erythrite plays in the immediate principles of certain lichens.

The paper of M. Peligot on the alloys of silver and zinc is here re-published from the *Comptes Rendus*. We learn from a note that the new silver coinage of reduced value is already in circulation in France. The new alloy is composed of 835 parts of silver and 165 parts of copper. M. Peligot's suggestion of the use of a mixture of silver and zinc has not been adopted in the coinage.

In a paper "*On the Transformation of Aldehyde into Alcohol*," M. Wurtz shows that this transformation is effected by the action of sodium amalgam on a dilute aqueous solution of aldehyde, but by no other means of procuring nascent hydrogen. Why this should be he states it is difficult to say.

In another paper "*On the Transformation of Valeral into Amylic Alcohol*," M. Wurtz shows that the product formed by the hydrogenation of valeral is not hydrate of butylene or pseudo-amylic alcohol.

M. Coulier, in a paper "*On the Rings of Phosphuretted Hydrogen*" describes a method of showing similar rings which we have heard of before, but may be new to some of our readers. The author recommends the use of a square wooden box with a lid like the lid of a pill box. A small hole is cut in the top of the lid, and the interior is filled with a thick vapour by placing within it two dishes, one with salt and sulphuric acid, the other with

sal-ammoniac and lime. When the box is full of vapour raise the lid a little and then shut it sharply down, whereupon a beautiful ring will be seen to issue from the hole at the top. If the hole is made at the side of the box, the ring is projected horizontally, and is better seen by an audience.

The last original paper in the number is by M. Lallemand, "*On the Relation of the Intensity of the Inducing to the Induced Current*." Most of the articles which appear in abstract in the review of foreign chemical works have already appeared in the CHEMICAL NEWS.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2237. Zoheth Sherman Durfee, Pittsburgh, Pennsylvania, U.S.A., "Improvements in apparatus for generating gas for fuel, and in furnaces for applying gaseous fuel to metallurgical and other operation."—Petition recorded September 13, 1864.

2316. George Scott, jun., Saint Helens, Lancashire, and James Tudor, Weston, Cheshire, "Improvements connected with the manufacture of salt cake."—Petition recorded September 21, 1864.

2336. Michael Henry, 84, Fleet Street, London, "Improvements in dyeing and tanning, and in preparing for dyeing and printing."—A communication from Flavie Victorine Augustine Autier, 33, Boulevard Saint Martin, Paris, France.

2338. Walter Bentley Woodbury, Manchester, Lancashire, "An improved method of producing or obtaining, by the aid of photography, surfaces in 'relievo' and 'intaglio' upon aluminous, vitreous, metallic, or other suitable materials."—Petitions recorded September 23, 1864.

2360. John Atkinson Harrison, Newcastle-upon-Tyne, "Improvements in applying to useful purposes the slag or scoria of blast furnaces used for smelting or melting metals and metallic ores."—Petition recorded September 26, 1864.

2364. Henry Bennison, Burrage-road, Plumstead, Kent, and Hobart Town, Tasmania, "Improvements in fluid meters." Partly his own invention and partly a communication from Frederick Arundel Downing, Hobart Town, Tasmania.—Petition recorded September 27, 1864.

Notices to Proceed.

1310. John Harcourt Brown, Strand, Westminster, "Improvements in treating animal substances for the manufacture of size, pulp, and pulpy matter, and converting the said pulp or pulpy matter into sheets, slabs, blocks, thread, hollow, or tubular articles, and such other articles of commerce for which the said sheets, slabs, blocks, threads, hollow, or tubular articles may be applicable."—Petition recorded May 26, 1864.

1355. Richard Eduard Donovan, Court Duffe, at Castleknock, in the County of Dublin, and Robert Bowles, Blackhall-place, in the city and county of Dublin, "Improvements in the means for the prevention of fraud by altering cheques, drafts, bills, I O U's, and documents of any description relating to the payment and receipt of money."—Petition recorded June 1, 1864.

1370. William Henry Mellor, Liverpool, Lancashire, "Improvements in self-acting mashing or saturating apparatus for the use of brewers, distillers, and others."

1375. Frederick Oldfield Ward, Hertford Street, Mayfair, Middlesex, "Improvements in processes and apparatus for treating alkaliferous minerals, to obtain alkalies, alkaline salts, alumina, and accessory products."—Petitions recorded June 2, 1864.

1418. Arthur Thomas Weld, Gravesend, Kent, and John Folliott Powell, Albion Place, Hyde Park, Middlesex,

"Improvements in the separation of animal substances from rags of mixed fabric."—Petition recorded June 7, 1864.

1506. Peter Spence, Smedley, New Hall, near Manchester, Lancashire, and Henry Davis Pochin, Broughton, Old Hall, near Manchester aforesaid, "An improvement in smelting copper ore."

1509. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "The manufacture of lyes or liquors applicable to the cleansing and bleaching of wool and other fibrous substances, as well as of textile fabrics."—A communication from Madame Rosine Saiglan Bagnères, Paris, France.—Petitions recorded June 17, 1864.

2060. Henry Parkes, Birmingham, Warwickshire, "Improvements in the manufacture of colours for dyeing, printing, and other uses."—Petition recorded August 19, 1864.

2193. James Fleming, Glasgow, Lanarkshire, Scotland, "Improvements in the treatment of tobacco leaf for the extracting of juice or liquor therefrom."—Petition recorded September 8, 1864.

2222. James Williams, Broad Quay, Bath, Somersetshire, "Improvements in apparatus connected with fermenting, charging, cleansing, or tunning vessels, casks, or vats."—Petition recorded September 12, 1864.

2252. Alfred Vincent Newton, Chancery Lane, Middlesex, "An improved mode of, and apparatus for, preventing incrustation in steam boilers."—A communication from George Tracey Parry, Philadelphia, Pennsylvania, U.S.A.

2254. Auguste Bertsch, Rue Fontaine St. George, Paris, "Improvements in lightning conductors for preventing atmospheric electricity damaging electric telegraph instruments."—Petitions recorded September 15, 1864.

2320. Edward Young, Oughtbridge, near Sheffield, Yorkshire, "Improvements in the manufacture and application of fire-resisting cements and materials."—Petition recorded September 21, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, October 17.

The school of horology at Cluses having lately been taken under State protection and suitably endowed, the horological school of Besançon applied to the Minister of Instruction to be placed on the same footing. A negative answer was, however, returned; the municipality of the town have therefore placed a suite of apartments at the disposal of the directors of the school, and have in addition voted them a large sum of money for the purchase of models and machines necessary for the instruction of the pupils. By the way, how is it that England, who stands at the head of the list as regards chronometers, watches, and public clocks, should utterly neglect the construction of domestic timepieces, and leave them in hands of the Germans, French, and Americans?

M. le Verrier is excessively wrath at both M. Charrière and the Abbé Moigno for objecting to his plan of transforming normal schoolmasters into meteorological observers. He announces his intention of sending M. Charrière's letter to all the normal schoolmasters in France, asking their opinion on it, and begging of them not to be angry. He then goes on to accuse the Abbé of personal vanity, and finishes by classing M. Charrière amongst "those individuals who constitute themselves philosophers by purchasing a barometer and thermometer, and then inscribe on their visiting cards—'M. X., Director of the Observatory of Z!'" The accusation of vanity is one that the Abbé can well afford to laugh at; but M. le Verrier either forgets or does not know that M. Charrière has been a most accurate and faithful meteorological observer for eighteen or twenty years past, and has published thirty-one tables of very valuable observations. I am afraid M.

le Verrier has lost his temper, as he did once before on the occasion of the discovery of a new planet.

A large and brilliant meteor fell near Tarbes on Saturday, September 24th. The detonation, as heard at Mount Stewart, near Pau, was so tremendous that the peasantry rushed out of their houses and fell on their knees, thinking the last day was coming. The sight from Pau was very splendid.

The sale of haschisch has been interdicted by the Turkish Government. Henceforth it can only be sold by chemists and druggists, for purely medicinal purposes. The *Gazette Médicale d'Algerie* wishes for an analogous prohibition in Algeria, where its abuse is carried to an alarming extent. If the use of haschisch is to be prohibited in Algeria, why should not *absinthe* be forbidden in the mother country? Any one who knows anything of the rising generation in France can tell fearful stories about the effects of this pernicious *liqueur* upon the system. The consumption of it is increasing every year, no less than seven and a half million litres having been imported from Switzerland during 1863, to say nothing of the enormous quantities made at home.

M. Morel, who claims to be the inventor of gun-cotton in France, affirms, in contradiction to the assertions of M. de Luca, that he has specimens of that substance which he has kept for eighteen years without undergoing the least alteration, and that when properly made gun-cotton will preserve its properties for an indefinite period. These assertions, I believe, agree with the experiments of General Lenk and Messrs. Abel and Scott Russell.

M. Berthelot's new work, comprising the whole of his lectures on Organic Synthesis, delivered at the College of France during the present year, is making a great sensation. He gives the *coup de grace* to the method of making alcohol from coal gas, by showing that the process is extremely costly and that the resulting alcohol is exceedingly impure. M. Berthelot ventures to hope that fibrin, albumin, ossein, &c., will ultimately be found in the laboratory, an expression that has caused great alarm in the minds of certain persons, who seem to think that M. Berthelot thereby assumes for science the power of creating living beings.

M. Tempel, of Marseilles, has just discovered a new planet, which makes the eighty-first of the group existing between Mars and Jupiter. Its brilliancy is that of a star of the 11th and 12th magnitude. The discovery has been confirmed by the observations of M. Luther, at Bilk.

In the *Journal d'Agriculture Pratique*, M. Barral gives some interesting details on the subject of the manufacture of animal manure at Aubervilliers. This manufactory consumes every year 8000 horses, 200 donkeys, 300 cows, 300 pigs, 9000 cats and dogs, 6000 kilogrammes of meat unfit for food, 500,000 kilogrammes of offal from the Parisian abattoirs, and 600,000 kilogrammes of other refuse animal matters, such as skins, horns, &c. The raw material is first cut up and boiled to extract the grease. The flesh is then separated from the bones, pressed, and dried. It is afterwards ground and sifted, and the dried bones, which are also submitted to the same process, mixed with it, forming a manure containing 35 per cent. of nitrogen and 55 per cent. of phosphate of lime. The blood is collected separately, and also made into manure. The soup obtained in the boiling is strained, and the solid matter thus collected is added to the rest. The offal is piled in alternate layers with other organic matter, such as wool and parings of horn and hoofs, with which is mixed a certain amount of mineral phosphates. The heap is well moistened with the strained soup, fermentation is set up, and the whole is gradually transformed into excellent manure. During this process the phosphate of lime breaks up into phosphoric compounds, more or less soluble, and various salts of ammonia are formed. This is really a much better use to put dead horses to than making them into *saucissons de Lyon* or *filets de bœuf* for the cheap *restaurateurs*.

New Process for Extracting Gold.

To the Editor of the CHEMICAL NEWS.

SIR,—I shall be glad if you will inform me why Dr. Crace Calvert calls his process for extracting gold *new*. Plattner first suggested the use of chlorine for the purpose in 1848, and it was tried with success in Silesia, and has already been suggested for poor Australian quartzes. See the essays published by the Government of Victoria, and freely distributed at the International Exhibition. A similar process was also published by Dr. Schwarz in the *Breslauer Gewerb-blatt*, somewhere in 1860, I think.

I am, &c.

A CHEMIST.

London, October 9.

Answer to a Query.

To the Editor of the CHEMICAL NEWS.

SIR,—If your correspondent will investigate the matter further, he will find that the iron which turned black in his sulphuric acid bath was either steel or a highly carburised iron.

I am, &c.

S.

MISCELLANEOUS.

Liebig on the Use of Sewage.—Another letter from Baron Liebig, on the use of sewage, has been made public, from which we make a few extracts. It will be seen that the Baron expresses an opinion to which we gave utterance a few weeks ago, namely, that the use of sewage without other manures would prove a delusion:—

“The natural laws which govern the permanent fertility of soils and the increase of their produce are, from circumstances which I cannot detail here, very little understood by the British farmers; and hence arises a fear that the use of sewage, which ought to be a lasting benefit to agriculture, may be regarded, after a few years, as a veritable detriment by the same farmer who, in the first years of its application, would assuredly give it his approbation. In what may be termed its natural state it is not a universal manure, like stable dung, which is efficacious at all times and on all localities, but a special manure, the continual application of which exclusively tends to impoverish the land.

“If clearly understood and properly managed, the employment of sewage will prove a blessing to agriculture; and those who by unwearied perseverance have at last seen the consummation of their labours may justly be looked upon as the benefactors of their fellow-men. But loud would be the outcry should the agriculturist, either by his own ignorance or the want of forethought in others, find himself misled. Our name would then become a byword, and instead of gratitude be recollected with a curse.

“There are two things which must be done—first, it must be made intelligible to all that sewage in its natural state does not replace stable dung in its entire efficacy, and that, if used exclusively, it will produce abundant crops *only for a time*; secondly, that in each crop the composition of sewage ought to be corrected, according to the nature of the soil, by adding those ingredients which are wanting in sewage, and which the plants to be grown require in the largest proportion.

“The composition of sewage being once perfectly known, a receipt for what is to be added could be made out and put in the hands of every farmer who uses it; and it remains a question whether it is not possible for the company itself to add those ingredients wanting in the sewage according to the demand of the crop to be grown.”

This last paragraph in the letter suggests a good deal of work, and we fear will make farmers hesitate about employing the sewage.

Sale of Cyanide of Potassium.—Suicides by means of cyanide of potassium have of late been so frequent as to suggest to chemists much more caution in retailing this highly poisonous salt. It is true that photography is a very popular art, and electrolytic gilding is occasionally practised by amateurs; but we may recommend chemists only to retail the salt to those personally known to them. By so doing many suicides will no doubt be prevented, and something will also be done to avoid the forced restriction on the sale of such articles which will inevitably be placed if the use of the cyanide for the purpose of suicide should extend.

The Influence of Petroleum in America.

Writing on this subject in the *Journal of Science*, Dr. Draper, of New York, says:—“The exact source of petroleum is, up to the present, uncertain, whether it has all been produced by distillation from bituminous coal, anthracite being formed at the same time, or whether it has resulted directly from the bituminous fermentation of marine plants antedating the coal and containing a larger proportion of hydrogen.” The amount thrown out by some of the wells is enormous. One of them ejected 3740 barrels a day, three 1000 barrels, one 800 barrels. To “strike ile,” has become throughout that region the synonym for rapidly growing wealthy. Transportation to market is effected by carrying it down the stream in vessels, many of which are merely tanks. Occasionally, when collisions occur, thousands of gallons are lost, floating away on the surface of the water. It is proposed to collect the fluid again by means of floating dams, shaped like a V, with the point up stream. The effect that this illuminating agent has produced throughout the country is very striking. It has entirely displaced all other means of lighting, except gas, and is used even in cities by many who desire an absolutely steady light. The great desideratum is, a perfect chimneyless burner. The petroleum requires a large amount of air for complete combustion of its carbon, and by no other means than a tube six or eight inches long has the supply been rendered sufficient. Although by the substitution of mica for glass the difficulty of breakage has to a certain extent been overcome, there is still great room for improvement. Kerosene, as the oil suited for burning is called, has in one sense increased the length of life among the agricultural population. Those who, on account of the dearness and inefficiency of whale oil, were accustomed to go to bed soon after sunset, and spend almost half their time in sleep, now occupy a portion of the night in reading and other amusements; and this is more particularly true of the winter season.

ANSWERS TO CORRESPONDENTS.

* * All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements and Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

* * In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Esperanza.—Hall's chlorate of potash is unknown to us.

A Chemist.—The process is a secret.

Photo.—It is not said what uranium salt is used, and we have never seen the preparation.

P. G.—(1) Richardson and Watts' “Chemical Technology,” Baillière. (2) A shilling a number. No new edition of Fresenius' “Quantitative Analysis” is preparing.

Communications received from Mr. Tichborne, MM Draper and Whitla, Mr. Catton, Professor Playfair; J. G. B.; P. Squire.

Books Received.—On Skin Diseases, by Tilbury Fox, M.D.; On the Spectra of Some of the Fixed Stars, by Wm. Huggins, F.R.A.S., and W. A. Miller, M.D., LL.D., &c.

THE REPORT ON THE SALE OF POISONS.

THE Privy Council may be congratulated on having secured the services of a very active and zealous Medical officer. In the receipt of a liberal salary, and in possession of a comfortable office, that indefatigable official watches from afar over the welfare of the community, and from time to time deposes some one else to inquire into, and report on, a variety of subjects which concern the public health. And thus it has happened that this year Dr. Alfred Taylor has been requested to report (1) to what extent is injury occasioned by the carelessness and incompetence of persons employed in retailing drugs; and (2) to what extent are unnecessary facilities given for the purchase of poison for criminal purposes.

In answer to the first of these questions, Dr. Taylor relates a number of cases which have occurred within the last thirty years, in which poison has been sold by mistake in grocers' and village general shops, and also a good many in which the mistakes have been made by regular druggists.

On the second question, relating to the facilities given for the purchase of poison for criminal purposes, after remarking that the sale of poisons in this country may be considered as open and free as it possibly can be, Dr. Taylor goes again over the same ground, relating the well-known cases of the Clifton buns, the Bradford lozenges, and the Stourbridge flour. In this section, however, he does respectable druggists some justice by stating his belief that they throw every impediment in the way of the purchase of poison; and he concludes his report with a string of suggestions, which we printed at page 180 of this volume. With regard to these suggestions we may say that they will in general command approval, since they are pretty much the same as have been put forward by chemists whenever the subject has been under discussion.

Mr. Simon comments on this report in a way of which we have but little to complain. We object to the introduction of the remark from the Registrar-General's Report that in the four years 1858-61 1059 cases of accidental poisoning had occurred, because it is likely to create a false impression. Taken in connection with what follows, it seems to suggest that all these fatalities have been caused by the mistakes of tradespeople. But the Committee of the Pharmaceutical Conference, who examined twenty-five cases, reported in the course of two years in the *Pharmaceutical Journal*, very properly pointed out that ten of these twenty-five mistakes were made by administrators of medicines. We know, further, that a number of accidents occur every year in manufactories; but allowing for these, we are sorry to say there yet remains a large number of fatal mistakes made by parties who, under any alteration in the law, must be entrusted with the sale of drugs and poisons. Hence arises the question of responsibility.

Both Dr. Taylor and Mr. Simon have made some strong remarks on the necessity for the establishment of some legal criterion as to what constitutes *culpable negligence* in the sale of drugs and poisons. This can never be defined by Act of Parliament, and we must presume that the judges know their duties as well as the writers of this report. We may admit, however, that the law as administered does seem lax on this point; but still not more so when dealing with poison fatalities than in many other analogous cases. A badly or hurriedly built house falls down and crushes a number of people in the ruins; there can be no doubt of culpable negligence of the ordinary pre-

cautions for safety, but no one is convicted for it. A patched and leaky boiler, which is known to have long been in a dangerous condition, one day bursts and causes the death of a number of people; there is culpable negligence on the part of some one, but the law lets him go free. Again, it is most certainly culpable negligence to dispense or sell from a bottle without taking the trouble to read the label; and so it is to take a gun and point it at another without taking the trouble to see whether or not it is loaded. In the latter case, however, a fatal accident is always considered a pure mischance. Now such accidents, or so-called accidents, as we have named, destroy and injure many more people than accidental poisonings, and we must take care that the law is not stretched to punish one particular class more than another.

Mr. Simon in this Report does not mention the "drunken shop-boy,"* who may dispense strychnia for quinine. The dissipated youth is spared the disgrace of another exposure; but Dr. Taylor testifies to the frequent employment of heedless and entirely unskilled persons in dispensing and vending medicines. The entirely unskilled we hope some day to see weeded out; for the heedless, we are bound to admit that a more liberal interpretation of the words *culpable negligence* might, perhaps, operate as a useful stimulus to carefulness.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Synthesis of Butyric and Caproic Acids,† by
ALFRED R. CATTON, B.A., Scholar of St. John's College, Cambridge, and Fellow of the Cambridge Philosophical Society.

WHEN a saturated solution of acetate of sodium in absolute alcohol is heated with sodium-alcohol for seventy hours, a number of compounds are formed in the isolation and examination of which I have been occupied for several months. My experiments are as yet incomplete, but I have obtained certain preliminary results, some of which it is the object of this paper to describe.

Amongst the compounds formed in the manner referred to are a number of acids of which I have isolated two, and found them to possess the molecular weights and general properties of butyric and caproic acids. The acids are only produced in small quantities, so that the investigation is attended with considerable experimental difficulties.

The apparatus used consisted of a retort which was heated in a sand-bath, and connected by an adapter with a Liebig's condenser, the whole being so arranged that the alcohol which distilled over might be condensed and flow back into the retort. The whole apparatus was dried, previous to use. One part of fused acetate of sodium and about fifteen parts of absolute alcohol were put into the retort, and then heated to the boiling point, which was about 113°—114°C. A quantity of sodium was then introduced into the retort in pieces, and the whole was heated for about seventy hours to the boiling point.

At the end of this time the contents of the retort had become of a dark coffee-brown colour. Excess of alcohol was then distilled off, and the whole of the residue in the retort dissolved in water, filtered from an insoluble

* Report on "History and Practice of Vaccination," 1857, p. lxiii.

† The experiments described in this paper were communicated to the Chemical Section of the British Association, September 16, 1864.

resinous-like substance, neutralised with acetic acid and the acetate of sodium partially separated by three crystallisations. The mother liquor, which was rendered slightly acid by the addition of one or two drops of acetic acid, gave a copious light brown precipitate with subacetate of lead.

The acetate of sodium used in these experiments gave no precipitate with subacetate of lead.

The precipitate was collected on a filter and washed with as small a quantity as possible of cold water. It was then suspended in a large quantity of cold water, and decomposed by sulphuretted hydrogen, the gas being passed for more than an hour as a portion of the precipitate appeared to be decomposed with difficulty by sulphuretted hydrogen.

The sulphide of lead was washed by decantations. Excess of sulphuretted hydrogen was expelled from the acid solution by heating and then passing a current of air through it.

The solution thus obtained was colourless and considerably acid to test-paper. The acid or acids thus obtained were, therefore, not acetic acid, but new acids produced in the process.

A part of the solution was neutralised with pure potash and evaporated. The liquid gradually acquired a faint yellow colour which by degrees became deeper, till at last brown scales began to be deposited. The brown deposit was separated by filtration, but it was too small in quantity for analysis.

Nitrate of silver produced in the filtrate a yellowish white precipitate, which was collected on a filter washed with cold water and dried at 100°C .

The silver salt, gradually became brown on exposure to light. I determined, nevertheless, to estimate the silver in a portion of the salt a proceeding which will be justified below.

·3894 grm. of the salt gave ·2729 grm. AgCl. The salt, therefore, contained 52·746 per cent. Ag. Butyrate of silver contains 55·3846 per cent. Ag.

Of course this is of no value as an accurate determination of the quantity of silver in the salt; but it is to be observed that the decomposition of the silver salt would go to augment the percentage of silver. If, therefore, with this decomposition the percentage of silver was less than butyrate, *a fortiori* it would have been if no decomposition had taken place.

The residue of this blackened silver salt was treated with a moderate quantity of boiling water, and filtered till the filtrate became perfectly colourless.

The solution thus obtained did not blacken on exposure to light. No crystals were deposited on cooling, owing to the solution being too dilute. It was, therefore, evaporated in the dark, in vacuo over sulphuric acid. The residue had a rancid odour, and did not blacken. It was dried at 100°C . ·0413 grm. gave ·0216 grm. Ag.

The salt, therefore, contained 52·30002 per cent. Ag. The last determination was 52·746 per cent. Ag.

The quantity, therefore, of the silver salt which had decomposed in the first analysis must have been very small.

From these analyses I concluded that the acid solutions consisted principally of an acid having the same molecular weight as butyric acid mixed with acids containing a higher percentage of carbon.

The problem now was to separate these acids from each other.

The reaction was now repeated from the commencement, and allowed to go on for about seventy hours. The acid solution was obtained as before by precipitation

with subacetate of lead and decomposition by sulphuretted hydrogen. It was neutralised with lime water, excess of lime separated by carbonic anhydride, warmed and filtered. After all the carbonate of calcium had been separated by gently heating and filtering several times, the solution was found to have a slightly alkaline reaction on reddened litmus. The liquid was then evaporated, and when reduced to about half its bulk a white flocculent deposit was formed; this could not be carbonate of calcium as it was non-crystalline, and did not effervesce with nitric acid; also it could not have been a basic calcium salt, for in that case the solution would have acquired an acid reaction. Hence the deposit must have been a neutral calcium salt only slightly soluble in water. It was collected on a filter; on evaporating the filtrate it gradually turned yellow, fresh deposits were produced, which became gradually smaller, and these were added to the first.

When the solution had reduced to about seventy parts of water to one of salt, a precipitate was formed more copious than before, and the solution at the same time acquired an acid reaction. The deposit in this instance was therefore a basic calcium salt.

On further evaporation, fresh deposits were formed, the solution becoming at the same time more strongly acid. It was, therefore, impossible to continue the evaporation in the heat further. The solution was, therefore, again neutralised with lime water, excess of lime separated by carbonic anhydride, warmed, filtered, and evaporated in vacuo over sulphuric acid.

The residue, which smelt like fresh butter, was distinctly separable into two portions, one of which was crystalline, the other amorphous. The amorphous portion had probably been first crystalline, and afterwards given up its water on remaining in vacuo.

The amorphous portion was carefully separated from the crystalline portion and dried in vacuo.

A determination was made of the amount of calcium in the salt.

The salt, on being heated, blackened readily, and gave off an odour resembling acetone. The calcium in the salt was first determined as carbonate of calcium. ·33 grm. of the salt gave ·1594 grm. carbonate of calcium, or ·06376 grm. Ca. The salt, therefore, contained 19·3212 per cent. Ca; butyrate of calcium contains 18·6915 per cent. Ca.

The excess in the quantity of carbonate found was, no doubt, due to the presence of a small quantity of carbonic acid, which would be expelled on heating the carbonate with concentrated sulphuric acid, and then converting it into sulphate. ·33 grm. of the salt gave ·2094 grm. sulphate of calcium, or ·06159 grm. Ca. The salt, therefore, contained 18·6636 per cent. Ca; butyrate of calcium contains 18·6915 per cent. Ca.

These analyses prove conclusively that an acid having the same molecular weight as butyric acid—viz., 88—is produced in the experiment.

I had not enough of the calcium salt to make a carbon and hydrogen determination.

This acid, having the molecular weight 88, possessed also the well-marked characters of butyric acid.

The calcium salt was completely soluble in 5·7 parts of water at 15°C .; but on being heated a considerable portion of the salt was deposited, which, however, redissolved on cooling. On being heated, it blackened readily, gave off an odour resembling acetone, and left a residue of carbonate of calcium.

The copper salt was sparingly soluble. On adding sulphate of copper to a solution of the sodium salt, an

immediate precipitate was produced, which, when collected on a filter, was of a bluish green colour. It was perfectly soluble in excess of cold water. No precipitate was produced except in tolerably concentrated solutions.

The silver salt was precipitated on the addition of nitrate of silver to one of the alkaline salts. It was completely soluble in boiling water, and the solution did not blacken on exposure to light.

The alkaline salts gave a copious white precipitate with subacetate of lead.

The sodium salt possessed in the most marked manner the property of rotating upon water. This property, so far as I am aware, is only possessed by the butyrates, propionate of barium, camphor, and eugenic acid (the latter, however, being a liquid). When the mixture of the sodium salts of the acids, obtained by precipitation with subacetate of lead and decomposition by sulphuretted hydrogen, was dissolved in alcohol, and then heated for a short time with sulphuric acid, on standing an oily layer rose to the surface, possessing the odour of the pine apple so characteristic of butyric ether, but not quite so fragrant, probably owing to admixture with the ether of some other acid. The smell of the ether, in fact, resembled more the commercial than pure butyric ether.

These experiments show that an acid having the molecular weight and general characters of butyric acid is produced in the reaction. It remains to show by further experiments that the acid has the same percentage composition, and that the more minute characters, as the crystalline form of its salts, &c., agree with those of butyric acid.

We have stated that the residue after evaporation *in vacuo* of the calcium salts was distinctly separated into two parts, one crystalline, the other amorphous.

In what precedes we have given the details of the examination of the amorphous portion. We now proceed to give the results of the examination of the crystalline portion. Very little of it dissolved in 5.7 parts of water, $\frac{3}{4}$ ths dissolved in 49.4 parts (caproate of calcium requiring for its solution 49.4 parts of water), and the residue did not dissolve entirely in 150 parts of water.

The portion soluble in 49.4 parts of water was evaporated to dryness *in vacuo*. The residue consisted of two parts, one of a light yellowish brown colour, the other quite white. The latter was carefully collected, and found to be soluble in 5.7 parts of water, from which I concluded it to be butyrate of calcium. The former, very curiously, was not entirely soluble in 49.4 parts of water. The soluble portion was again evaporated *in vacuo*. The residue had exactly the same smell as before. It was soluble in 46 parts of water; and as caproate of calcium requires 49.4 parts, I concluded that it consisted of caproate of calcium still mixed with a small quantity of butyrate. The quantity was too small to admit of the caproate being separated from the butyrate of calcium by crystallisation.

A quantity of nitrate of silver, exactly equivalent to the weight of the salt, on the supposition of its being entirely caproate of calcium, was then added to the solution in crystals. The precipitate was collected on a filter, washed with the smallest possible quantity of cold water, and dried at 100° C. It did not blacken on exposure to light. .136 grm. of the salt gave .09 grm. AgCl, or .0677 Ag. The salt, therefore, contained 49.7794 per cent. Ag. Caproate of silver contains 48.4559 per cent. Ag. The excess in the quantity of silver was, no doubt, due to admixture with butyrate of silver.

To return now to the portion of the original crystalline residue, insoluble in 49.4 parts water.

It was collected on a filter, and dried at 100° C.

It was natural to suppose that this was the calcium salt of some higher acid, as caprylic acid.

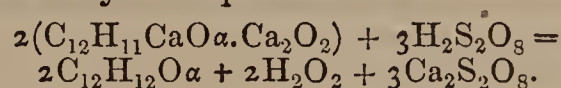
The following calcium determination proves, however, that such could not be the case:— .046 grm. of the salt gave .0501 grm. sulphate of calcium; .046 grm. caprylate of calcium give .0192 grm. The calcium salts of all higher acids giving less.

Nor could the salt be acetate of calcium; its solubility in water is sufficient at once to negative such a supposition, and .046 grm. acetate of calcium gave .0396 grm. sulphate of calcium.

Now, the fact that a solution of caproate of calcium deposits a basic salt when heated suggests the possibility of the salt being a basic caproate of calcium.

The composition of this basic salt has never been determined. Let us assume it to have the simplest composition of a basic salt—viz., $C_{12}H_{11}CaO\alpha.Ca_2O_2$.

Its decomposition by sulphuric acid would take place as represented by the equation—



Hence .046 grm. of such a salt would give .0491 grm. of sulphate of calcium. .046 grm. of the salt referred to gave .0501 gr. sulphate of calcium. The difference between these is only one milligramme.

There can, therefore, be no doubt that the portion of the crystalline residue insoluble in 49.4 parts of water was a basic caproate of calcium having the formula $C_2H_{11}CaO\alpha.Ca_2O_2$.

(To be continued.)

On the Artificial Production of Anhydrite,*
by M. ALPHONSE GAGES.

THE circumstances under which natural anhydrite is formed have not yet been well determined. The experiments already made, and bearing upon the various properties of the sulphate of lime and its behaviour at various temperatures, although presenting a great interest, have not yet given crystallised anhydrite under the same conditions as it occurs in the saliferous formations. Gay Lussac had already observed that over-heated gypsum partially lost its well-known properties, and he attributed the cause of it to the partial formation of anhydrite. The experiments of Graham proved, also, that gypsum passes into a kind of amorphous anhydrite at a temperature of 204°. On the meeting of the British Association in Dublin, Dr. Sullivan gave an account of some experiments by which he obtained anhydrous sulphate of lime from its solution in water at a temperature of about 300° Centigrade. The mixture of gypsum and fused salt, treated by water, leaves undissolved prismatic lamellar crystals of anhydrite. Left for many days in water, the quantity of moisture absorbed did not exceed that which some varieties of the natural anhydrite would have absorbed if placed under the same circumstances. I give here the results I obtained:—

Water	.	.	.	.	.	0.472
Lime	.	.	.	.	.	38.531
Acid sulphuric	.	.	.	.	.	60.942

100.945

Gypsum melted with anhydrous sulphate of soda gives also crystals of anhydrite, but the formation of anhydrite

* Read at the meeting of the British Association.

in sulphate of soda requires a higher temperature; but the crystals of anhydrite, separated by water from the sulphate of soda, were perfectly anhydrous. Analysis gave the following, namely:—

Ca.O.	:	:	:	:	40.952
SO ₃	:	:	:	:	59.085
					100.037

Mitscherlich fused gypsum at the highest temperature of the porcelain furnaces, and obtained a white crystalline mass of anhydrite. The occurrence of anhydrite amongst rocks of a sedimentary origin, and the necessity of a temperature higher than the melted lava, has been the great argument employed to prove the impossibility of anhydrite having been formed by fusion. Anhydrite occurs along with rock salt, clays, &c., presenting itself no regular stratification. If we could consider melted chloride of sodium as the solvent in which anhydrite had been produced, the problem would be solved at once, as gypsum dissolves and crystallises in common salt at a temperature far below the melted lava, and not rising above a dull red heat temperature, to which local circumstances may give rise, at such temperature the liquid may possess a great fluidity.

On the Separation and Estimation of Cerium, by WALTER GIBBS, M.D., Rumford Professor in Harvard University.

THE precipitation of cerium in the form of oxalate from a slightly acid solution is, unquestionably, the most satisfactory method of separating the oxide. The estimation of the oxalate upon a weighed filter is accompanied with the usual trouble and loss of time in perfectly drying the filter before and after collecting the precipitate upon it. By the following mode of proceeding these difficulties may be easily and completely avoided. The solution of cerium (I understand here the usual mixture of cerium, lanthanum, and didymium) when neutral, is to be rendered slightly acid by sulphuric or chlorhydric acid, and then largely diluted with water. Half a litre of water for every estimated gramme of oxide is a good working proportion. The solution is then to be boiled, and a hot solution of oxalic acid or oxalate of ammonia added. On cooling, especially when the solution has been well stirred with a glass rod, or shaken, the oxalate separates in large crystalline grains of a pale rose violet colour. The precipitate is to be filtered off and well washed with boiling water, the washing being extremely easy in consequence of the coarse granular character of the precipitate. The filter is then to be pierced, and the oxalate carefully washed down into a crucible; after which the water in the crucible may easily be removed by evaporation, and the oxalate dried at a temperature of 100° C. The equivalents of lanthanum and didymium are so near to that of cerium, that no very sensible error is committed by considering the mixed oxalates as consisting simply of $\text{CeOC}_2\text{O}_3 + 3\text{aq}$.

In mineral analysis, in which the relative quantity of oxygen in the acids and bases must be determined with accuracy, it may be desirable to ascertain the quantity of oxalic acid in a weighed portion of the oxalates by combustion with oxide of copper. From this the acid in the entire precipitate may be found, and the oxygen in the three bases will then be one-third of the oxygen in the acid.—*American Journal of Science*, vol. xxxvii., p. 354.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, F.C.S.

(Continued from page 196.)

9. **John Rey.**—About the year 1628 a M. Le Brun, of Bergerac, calcined 2 lb. 6 oz. of tin, and found on weighing “to ascertain the loss,” that the calx weighed 2 lb. 13 oz. He next repeated the experiment with the same weight of lead, and found a loss of 6 oz.* Le Brun mentioned the experiment to several of his friends, but not one of them could give an explanation of the cause of the effects observed, and ultimately he applied to John Rey,† an ingenious physician of his acquaintance residing at Bugue, in Perigord.

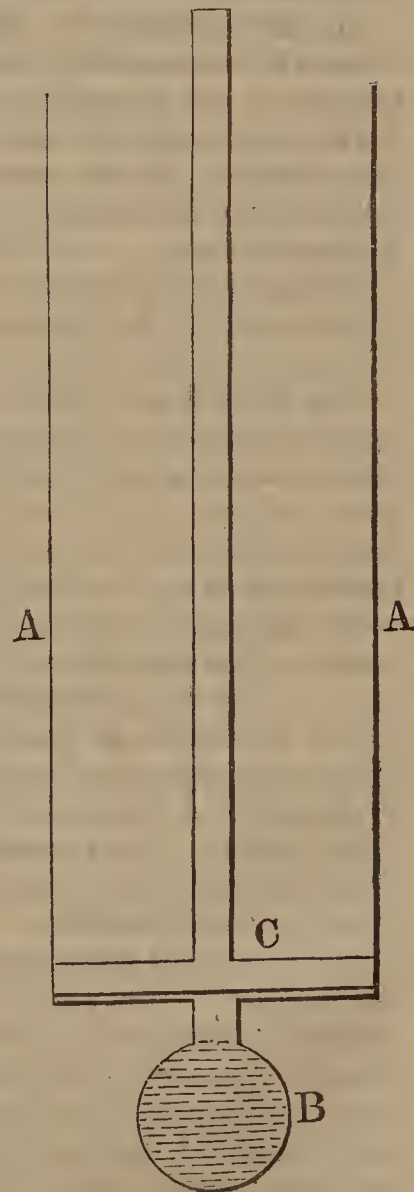
The subject was investigated by Rey, and the results of his inquiry were published in 1630 at Bazas, a small town in Provence.‡

Rey's first object was to prove that the air has weight: taking it for granted that bodies cannot descend unless they possess weight, we must admit, he says, that air possesses it, because if we pull a stake out of the ground, air at once rushes in and fills the hole which is left; and however deep we may dig a well, air will descend into it and completely fill it. He mentions, moreover, that if air is compressed in a balloon, the latter on weighing will be found to be heavier than before.

When certain liquids of different density are mixed together they are afterwards found to separate into distinct layers; so, argues Rey, if a long tube were filled with wine the upper layer would be more spirituous than the lower, and hence he infers that the air on the top of a mountain is less dense than that at its base.

Rey believed that water, by the action of heat, is converted into air, and he describes a method of determining the volume of air produced from a known volume of water. A hollow cylinder of metal, AA, open at one end, has an orifice made in the closed end, into which the beak of a small elopile, B, can be fitted air-tight. A piston, C, moves freely in the cylinder. The piston is forced down to the bottom of the cylinder, and the elopile, filled with water, is then securely fitted into its place. Heat is applied to the elopile until the water it contains is completely converted into vapour, and the height to which the piston is raised is noted. By comparing the capacity of the elopile with that of the cylinder below the piston, the relation of the space occupied by the water to that of the space occupied by the vapour produced from it can obviously be readily determined.

The eleventh of Rey's essays is entitled “L'air est rendu



* This loss was due to an error of manipulation, arising either from the heat of the furnace being too intense, and too long continued, or from the action of the fused oxide on the crucible.

† Born at Bugue during the later part of the 16th century. Died 1645.

‡ Rey's work is entitled “Essays de Jean Rey,” Docteur en Medecine.

pesant par le separation de ses parties moins pesantes." Just as in distilling wine, a distillate more subtle than wine passes over, and a residue more dense than wine is left in the retort, so, argues Rey, air may be distilled, a "thickened air" being left as residue. We know that air is thickened by the heat of the sun, because soon after sunrise a trembling of the air is sometimes observed. Now, the air near a furnace also trembles, and is therefore thickened. "For the violence of the fire, subtilising all the air that comes near it, will drive an immense quantity of it to a distance, leaving around itself of this immense quantity only a kind of dregs, which from its glutinous weight cannot fly off."

The sixteenth essay is entitled "Response formelle à le demande pourquoy l'estain, et le plomb augmentent de poids quand on les calcine." "To this question, then," he writes, "resting on the foundations I have laid, I answer *et soustiens glorieusement*. That this increase of weight comes from the air, thickened, and made heavy, and in some degree rendered adhesive in the vessel by the violent and long-continued heat of the furnace, which air mixes with the calx (its union being assisted by the continual stirring), and attaches itself to its smallest particles; no otherwise than as water when sand is thrown into it makes it heavier by moistening it and adhering to its smallest grains."

In the eight following essays Rey refutes the opinions of Cardanus and Cæsulpinus, and of several friends of Le Brun; who attributed the increase of weight to the absorption of "the vapours of charcoal," of "the volatile salt of charcoal," of "the volatile mercurial salt," of "moisture attracted by the calx," and of matter removed from the calcining vessel.

In the twenty-fifth essay Rey mentions a single experiment which refutes the opinions of all his adversaries. It will be observed that the above objections are founded on the mode of heating the metal to be calcined; Rey now proves that heat and air alone produce the change.

Hamerus Poppius || mentions an experiment in which

cine: Sur la recherche de la cause pour laquelle l'estain et la plomb augmentent de poids quand on les calcine." The dedication is to the Duc de Bouillon, and is signed "Rey, au Bugue, lieu de ma Naissance dans votre Baronnie de Lymail: le premier jour de Janvier, 1630." The treatise is in the form of twenty-eight short essays, extending over 144 small pages. It is *extremely rare*; a reprint was published in Paris by M. Gobet in 1777, and a translation by Mr. Children appeared in the 21st, 22nd, and 23rd volumes of the *Quarterly Journal of the Royal Institution* for 1821 and 1822. I have consulted the original 1630 edition (of which there is an excellent and complete copy in the British Museum Library), and Mr. Children's translation.

The following curious lines by a M. Bèreau, are printed at the commencement of the essays:—

"Icy de plus en delaisant,
Des siecles passez la creance,
Vous trouverez l'air se pesant
Qu'on l'examine a la balance.
Vous verrez que cet element,
Se pese en soy par accident,
Vous verrez comme il se r'affine;
Et par un miracle nouveau
Peu s'enfant qu'il ne se calcine
Par l'effort d'un rouge fourneau."

§ Rey undoubtedly here alludes to the unsteady appearance which objects possess when seen through air having a different density from that around it,—an effect due to the alteration of the refractive index of the heated air. It sometimes happens after a very hot day that there are layers in the air possessing different densities, the layer in contact with the soil being heated, and then ascending to make way for colder air. Astronomers are frequently unable to work on account of the unsteady appearance of the objects they view—an effect due to the same cause.

|| I am unacquainted with this author, neither can I find his name mentioned in the "Biographie Universelle," the "Nouvelle Biographie Générale," Watt's "Bibliotheca Britannica," nor in the catalogue of the British Museum Library. The quotation given in the text is from a work entitled "Basilica Antimonii Comprobata et Conscripta ab Hamero Poppio Thallino Philochymico," cap. iii. "De calcinatione Antimonii per Radios Solares." This work is printed in the "Praxis Chymiatrica" of Jean Hartmann, published in 1625.

he calcined antimony by converging the rays of the sun upon it by a lens. So soon, he writes, as the cone of rays is directed on the antimony, "cum multi fumi profusione calcinabitur . . . et (quod mirabile) licet copiosus fumus multum de antimonio dissipari arguat, tamen antimonii pondus post calcinationem auctum potius quam diminutum deprehenditur." Now, in this instance, Rey argues, it is impossible that "the vapours of charcoal," or any of the other volatile bodies supposed to be produced during the calcination in a furnace could have attached themselves to the calx, and yet it was found to weigh more than the antimony which produced it.

Rey next answers the question why a calx does not increase in weight *ad infinitum*. Following up the analogy of sand moistened with water, he replies, you may mix sand with sand and water with water in any quantity you please, but this cannot be done with sand and water, for if you add water to sand until it is thoroughly wetted, the sand will take up no more water; it is thus with the calx, the thickened air attaches itself to its most minute parts, "mais quand tout en assublé, elle n'en scauroit prendre davantage."

Certain bodies, such as lead and tin, have but little volatile matter, and consequently leave a large quantity of ash to attract the thickened air; while other bodies, such as vegetable and animal substances, have a great deal of volatile matter, and consequently leave but a small quantity of ash to attract the thickened air. In the first instance, the air attracted by the calx weighs more than the matter expelled by heat; in the second instance, the air attracted by the calx weighs less than the matter expelled by heat; hence the former class of substances gain weight during calcination, and the latter lose weight—such was Rey's explanation of the fact that all bodies do not gain weight during calcination.

Rey, by careful observation, became convinced that the weight gained by metals during calcination came from the air alone; it was then necessary to construct a theory to show by what means air could produce such an effect; the train of reasoning which induced him to propound the theory given above may be stated in a few words as follows:—Air has weight; air most nearly approaches the nature of a liquid, and may therefore be supposed to act like one; liquids may, by the action of heat, be caused to separate into a heavier and a lighter part; therefore, air may, by the action of heat, be caused to separate into a heavier and a lighter part; the heavier part approaches more nearly to the nature of a liquid than air, it is the "dregs" of air, and it has changed its fluidity for a "viscid grossness;" this matter attaches itself to the ashes of bodies during calcination as water attaches itself to sand, and renders such of them as possess much ash heavier than they were before calcination.

Rey did not believe that "thickened air" (*l'air espessi*) is the cause of calcination; he held to the old theory that calcination is the expulsion by heat of the volatile matter of the body calcined, the calx being the residual ash—the ash of an organic body was to his mind as much a calx as the oxide of a metal.

The great merit of Rey was, that he regarded air in the light of a ponderable liquid; that which holds good for a liquid, he assumed, holds equally good for air; he thus became able to grapple with an intangible body, and to reason on that which had hitherto from its subtlety eluded the grasp of the philosophers of all previous ages.

Rey's theory was, indeed, fallacious; still, it was a great step in advance of all that had been done in

former ages; there is impressed upon it the stamp of a great and energetic intellect. We must not judge of it by what has been done since; we must think of what was done before; we must think of it as the work of a man removed from a great centre of learning; from the converse of scientific men; from every external source of knowledge; compelled to work alone, to think alone. Let it be remembered, moreover, that experimental science had not yet left its cradle; middle age superstition was still very rife; philosophy founded on reasoning had not given way to philosophy founded on experiment; the syllogism had not yielded its place to induction; the Church was still dominant—still condemned all that was contrary to the philosophy of Aristotle, and thus cramped and curbed the human intellect; the “Novum Organum” had but just appeared; and the “Dialoghi” of Galileo were as yet unknown to the world. Rey lived at the commencement of an epoch, and he was the founder of a branch of scientific inquiry which helped to render that epoch glorious. By energy and perseverance he ascended a lofty eminence, whence he saw in the distance an unknown country—dimly, indeed, and far from him; still it was there—and he pointed out its direction to his fellow-men, but explorers were rare in that day, and men cared not to venture across pathless wastes, to ascend hitherto untrod mountains, in order to arrive at that which when found, might prove a barren and unproductive country.

Rey's work was but little known during the 147 years which intervened between its publication and its reprint in 1777. It was published in a small and obscure town of Provence, and from the fact that at the time of the reprint it was extremely scarce, it is to be supposed that only a few copies were originally printed. Had it been better known, the theory of Phlogiston would never have been propounded, and pneumatic chemistry would assuredly sooner have attained the rank of a science. But soon after the “Essays” were published, the discovery of the pressure of the air diverted the minds of the scientific from the study of the chemistry of the air.

The claims of Rey have never been sufficiently acknowledged. Let all honour be given to him; science ought to venerate such a man—a true philosopher, working for her, and loving her for herself alone. In the history of pneumatic chemistry, the name of Rey deserves to stand side by side with those of Mayow, Hales, Priestley, Scheele, and Lavoisier.

Well did Rey write as the concluding words of his treatise:—

“Le travail esté mien, le profit en soit au lecteur, et à Dieu seul la gloire.”

TECHNICAL CHEMISTRY.

On Pyroxylin, by MM. PELOUZE and MAUREY.

(Continued from page 198.)

Composition of Pyroxylin.—In 1847 we determined the composition of pyroxylin, and represented it by the following formula— $C_{24}H_{17}O_{17.5}NO_5$.

We must first find out whether we operated on a product different to Lenk's pyroxylin, and, if the two are chemically identical, whether this formula is correct.

We have conducted these researches with the greatest possible care, and believe we have surmounted the difficulties of the combustion of pyroxylin. We found the pyroxylin of Hirtenberg and Bouchet chemically identical, and found for them a formula differing from the previous one by only one equivalent of water.

This formula is $C_{24}H_{18}O_{18.5}NO_5$.

It is so like the previous formula— $C_{24}H_{17}O_{17.5}NO_5$ —that analysis alone would not be sufficient to justify the alteration without being supported by the amount of the yield. In fact, the new formula supposes a yield of 177.78 of pyroxylin for 100 of cotton, while the old formula corresponds to a yield of only 175. The direct experiments described above gave the figure 178.

All the gun-cottons we analysed were previously washed in a mixture of alcohol and ether, to remove some millièmes of fatty and soluble matters, then dried for several hours in a stove at a temperature between 40 and 50°.

All were of the composition above described, and gave the following figures:—

Carbon	.	.	.	.	.	25.00
Hydrogen	.	.	.	.	.	3.13
Oxygen	.	.	.	.	.	59.72
Nitrogen	.	.	.	.	.	12.15
						100.00

The Action of Heat on Pyroxylin.—General Lenk ascribes the unsatisfactory results obtained in France by the Commission of 1846 to the fact that not sufficient attention was paid to the manner in which the pyroxylin was prepared, and to operating upon an insufficiently defined nitred product. By taking advantage of conditions most favourable to nitrogenisation, he believes he has obtained a pyroxylin very difficult to decompose.

We will not discuss the theoretical value of this assertion, which does not seem to us to be very great. It is, on the contrary, more probable that gun-cotton would decompose more readily the less like cellulose, and, consequently, the more nitred it became. However this may be, General Lenk says that pyroxylin made by his process will not explode below 136° C.

We have made this important point the subject of numerous experiments.

These experiments were first made with an experimental matrass, open or closed, and plunged into a bath of boiling water.

All the samples heated in this way to 100° were sooner or later decomposed, and in a few minutes a disengagement of nitrous vapours took place.

The decomposition takes place in different ways, and cannot be reproduced at will. Four methods of decomposition at 100°, having the common characteristic of the disengagement of nitrous vapours, may be given:—

1. The pyroxylin detonates violently.
2. It decomposes without detonating, leaving a white, pulverulent, acid residue, partially soluble in water, containing no nitrogen, and forming about half the weight of the pyroxylin.
3. It leaves a yellow, amorphous, inexplosible residue, partially soluble in water, and reducing, like glucose, the double tartrate of copper and potash.
4. It gives a small residue (only 8 to 10 per cent. of its weight), and a black matter, in appearance like charcoal. In this case the matrass is entirely covered with a yellow powder, which dissolves in alkali with considerable disengagement of ammonia (this matter is apparently ultimate of ammonia). From this solution acids precipitate a dirty yellow body, also soluble in alkalis. The charcoal-like residue disengages ammonia under the action of potash. This production of ammonia by the simple action of heat from a matter formed of nitric acid and cellulose is very remarkable.

Other experiments made on various pyroxylin at

90° and then at 80° gave exactly the same results, except that decomposition took place after several hours instead of a few minutes.

At 60°, and even at 55°, pyroxylin is still decomposed. After a few days the matrass becomes full of dense reddish vapours, and the same non-nitrogenised pulverulent residue of which we have already spoken is obtained. No combustion was observed in these latter experiments.

We moreover produced detonation by putting about one gramme of pyroxylin into one of Gay-Lussac's copper stoves containing oil at only 47°. The pyroxylin thus decomposed was from a specimen prepared by forty-eight hours' immersion, and washing by Lenk's process.

These experiments plainly show that, contrary to General Lenk's assertion, his pyroxylin does not offer more resistance to the action of heat than that of Bouchet, the Austrian silicated pyroxylin having under all conditions behaved itself in the same manner as the others.

From its decomposing at about 50°, it may be asked whether pyroxylin is not liable to decompose even at the ordinary temperature. Is it, for instance, likely to detonate spontaneously when kept in large masses in magazines? Several chemists have given examples of the decomposition of pyroxylin at the ordinary temperature. They have generally mentioned as products of this decomposition nitrous vapours and several oxidised bodies like formic, oxalic, and acetic acids, and residues of gummy or saccharine substances, and have endeavoured to ascribe these instances of the alteration of pyroxylin to imperfect washing.

We will in the first place remark that it is easy to wash small quantities of materials, and that as the destructive action of sulphuric acid on pyroxylin is perfectly established, it is evident that the greatest care should be taken to eliminate every trace of it, and that consequently the most careful washing is necessary.

Without entering into the details of the known cases of the decomposition of pyroxylin at the ordinary temperature, we will describe the decomposition we observed in some specimens made in 1847, which had been washed with especial care either in pure or alkaline water.

Of twenty-eight samples placed in small stopped flasks, and a few grammes in weight, sixteen underwent alteration of some kind.

We took at hazard one of the altered specimens, and examined it. It was originally composed of six grammes of pyroxylin which had been washed in potash water and left since March 17, 1850, or fourteen years, in a flask imperfectly stopped. It had left a residue representing 79 per cent. of a dark yellow colour, and considerable amount of acid, but no sulphuric acid. This residue dissolved completely in water, and like glucose reduced tartrate of copper and potash. Its boiling solution gave a decided odour of vinegar, and, what was very remarkable, disengaged ammonia under the action of potash.

There are, then, under the ordinary atmospheric conditions, incontestable instances of the spontaneous alteration of pyroxylin, which, moreover, had been washed in alkaline water.

Now we have shown that pyroxylin is sure to decompose with heat, that in some cases it detonates, and in others apparently identical it is destroyed without combustion. Why should it not be the same at a low temperature? Why should we not add to the instances of simple decomposition those of detonation? The analogy is so evident that we need not have recourse to

the supposition of imperfect washing to explain the combustion of pyroxylin.

The Hirtenberg pyroxylin itself exploded in the magazine at Simmering, and in the investigation made July 31, 1862, it was merely decided that the accident was due to spontaneous combustion. It has also been attributed to the ordinary powder also contained in the magazine, but this supposition is inadmissible, as for several centuries there has been no known instance of spontaneous combustion of gunpowder. We must not of course, as was done in an Austrian paper, confound accidents during manufacture, carelessness of workmen, or faulty mechanism, with the explosions produced by no other cause than the reactions among the elements of the compound.

Comparison of Lenk's Pyroxylin with those of Bouchet relative to their Propulsive and Blasting Qualities.—It remains for us to give the results of the experiments made with Navet's pendulum to compare the propelling powers of these two kinds of gun-cotton. Twenty-five charges were fired with Lenk's pyroxylin, fifteen with those of Bouchet, three grammes for each charge, and round balls weighing each 25 gr. 50.

Taking first the medium velocity of the balls and then the greatest and the least, we have,—

	Gun-cotton.	
	Hirtenberg. m.	Bouchet. m.
Medium velocity.	385·36	394·32
Greatest „	441·53	485·94
Least „	357·63	357·63

Differences much greater than those presented by the above figures are sometimes found in firing from the same specimen. For instance, the pyroxylin brought from Austria by General Lenk was fired twice, giving—

	m.
On February 17	374·40
„ March 8	408·40

From these results we may conclude that both kinds have the same ballistic force.

In these experiments the gun was filled to the height of 0·05m. It was proposed to ram it harder, reducing the height to 0·03m; but the first charge fired by this method, and with three grammes of General Lenk's pyroxylin, burst the gun barrel.

This accident has also happened in firing charges of the Bouchet pyroxylin, showing the resemblance between the explosive property of the French and Austrian pyroxyles.

We will not here describe all the attempts made by the Commission of 1846 to obviate the inconvenience arising from the too rapid combustion of pyroxylin, but will confine ourselves to those made for the same purpose by General Lenk.

He first unsuccessfully tried compressed cartridges, then some which he called long cartridges, formed of paper cylinders covered with gun-cotton yarn. With these an Austrian 12-pounder charged with about 481 grammes of gun-cotton gave a velocity of 427 metres.

But this speed, though the greatest attained by the experiments in question, is less than that obtained in France with a similar gun, and with a charge of 2 kilogrammes of ordinary powder, which was about 480 metres, and which the Commission of 1846 endeavoured to attain by using 667 grammes of pyroxylin.

Now, it has not been proved that Lenk's cartridges would not injure pieces of ordnance were the quantity of pyroxylin increased so as to obtain the same speed as in France.

The author of one of the Austrian reports recognises the fact that the results obtained are unsatisfactory, and that the mechanical means employed to prevent the development of the injurious properties of the pyroxylin neutralise part of its propelling power; and arrives at the conclusion that the problem will be resolved only when firearms are made in which the injurious effect may be disregarded. This is also our opinion; but how to overcome the objection of the spontaneous explosions, which to us is the first consideration?

The result of our researches is that though the composition, method of production, and chemical properties of pyroxylin may be better known, the principal point—its use for firearms—remains in nearly the same state in which it was left by the French Commission of 1846.

There is nothing to lead us to suppose it possible, in the present state of our knowledge, to prevent the spontaneous explosion of pyroxylin, or to get rid of its injurious properties.—*Comptes Rendus*, lix., 363. 64.

PHARMACY, TOXICOLOGY, &c.

On the Extraction of Cantharidin, and on the Assay of Cantharides, by M. MORTREUX.

HAVING observed that cantharidin is insoluble in sulphuret of carbon, it occurred to me that this property might be employed in isolating the active principle of cantharides.

If cantharides are treated by chloroform, as has been indicated by Mr. William Proctor, and the solution is evaporated, the cantharidin is obtained in the form of crystals disseminated in solid fat and green oil.

By now employing the sulphuret of carbon, this vehicle dissolves the fatty bodies, and leaves the cantharidin nearly pure, which it is easy to collect on a filter and wash and weigh.

The study that I have made of these facts leads me to found on them a process for assaying cantharidin in cantharides. Here is the *modus operandi* I offer:—

Introduce into the adapter of Payen's apparatus, for extraction by vapour, (a vapour percolator,) a wad of cotton, and on this a layer of fine washed sand, 10 to 15 millimetres.

The cantharides to be examined being reduced to fine powder, 40 grammes (617 grains) are taken and placed on the layer of sand, when it is settled by jarring the beak of the adapter on the table; over the cantharides is put a thin layer of cotton, and above this a circle of filtering paper.

The adapter is then inserted in a flask containing three or four cubic centimetres of ether, which flask is connected by a lateral tube with another flask surmounting the adapter. The apparatus is then heated in a water-bath, and when the vapour arrives in the upper flask about sixty cubic centimetres of concentrated ether are poured in the adapter and a safety tube adapted.

The distillation is continued until the liquor passes colourless (about three hours are required), when the apparatus is removed from the water-bath; the upper flask removed, ten cubic centimetres of ether added, and on this disappearing below the paper, water is poured on to displace the ether. The ether is distilled off, and the residue, after the total disappearance of the ether, is treated with fifty to sixty cubic centimetres of sulphuret of carbon, and the whole thrown upon a double paper filter and well washed with sulphuret of carbon by means of a pipette.

The filters are then dried and weighed, the difference

in weight between the empty filter and that containing the cantharidin gives the weight of that principle contained in forty grammes of the cantharides treated.

By this method, in several assays, the product has ranged between eighteen and twenty-two centigrammes per forty grammes, an average of 20 centigrammes in 4000 centigrammes.* This process can easily be applied to the preparation of cantharidin for commerce.—*Jour. de Pharmacie*, Juillet, 1864.

On the Extraction and Preservation of Aromata, by CHAS. R. C. TICHBORNE, F.C.S., &c.†

SOME time ago I noticed in my garden a vegetable curiosity. As I was desirous of preserving this *lusus naturæ* for some time, I submerged it in some weak glycerine, considering that that fluid would be less likely to destroy the tender organism, and also remembering that it had been found most efficient in the preserving of animal tissues.‡ The glycerine answered its purpose admirably, preserving the delicate parts of the plant—preventing decomposition. I immediately saw that this property of glycerine might be made available for certain pharmaceutical purposes where it was desired to preserve or to extract the aromata of vegetable products. It is applicable to the preserving of elder, orange, or rose flowers, and also, as will be shortly explained, it may be substituted for the oils and fats used in the process termed enfleurage.

The flowers may be preserved for making the officinal *aqua sambuci* for an indefinite period, the following being the *modus operandi*:—The elder flowers should be gathered when the corolla is fully expanded, but not too far gone; they should then be plucked from the stem, and packed firmly in wide mouthed bottles, or jars, without crushing them; the whole should then be well covered with glycerine and corked. It is not necessary that the glycerine should be pure for this purpose, but it should be devoid of odour, and have a specific gravity of about 1.240 at 60° F.§

The common glycerine made from soap or plaster has generally a slight odour, which must be got rid of before using it.

When the flowers are wanted for the distillation of the water, they are put into the still, or, what is preferable, the glycerine is expressed, and is then found to be saturated with the essential oil; water is then added, the quantity being regulated by the original weight of the preserved flowers.

I have preserved flowers for two years, and on distilling them this summer I have procured a water, the perfume of which has equalled the most recent product. As the otto seems soluble in all reasonable proportions, this is a very convenient method of making a concentrated water, either by treating the glycerine after expression with a fresh portion of flowers or by regulating the amount of water added on distillation.

This process of preserving the flowers will be found to far exceed the old plan in general utility, but in particular, as it is almost next to impossible to distil the

* This is more than was found by Warner, who obtained 2.03 parts from 500, or 0.4 from 100, whilst the above is 0.5 per cent.

† Read at the Pharmaceutical Conference. We have already published a short abstract of this paper, but now print it at length. We shall do the same with other papers read at the Pharmaceutical Conference as they reach us.

‡ Experiments of M. De Marquay—*Journal de Chimie Medicale*.

§ Pure distilled glycerine has generally a specific gravity of about 1.242 at 60° F.; but the ordinary glycerine may be concentrated upon a water-bath until it has a specific gravity 1.240.

flowers so preserved without a small portion of the salt being mechanically carried over, which cannot be a desideratum in an emollient.

By shaking the expressed glycerine, diluted with warm water and melted lard, and then allowing them to separate, an ointment may be obtained which has the natural properties and aroma of the elder flowers.

I will now draw your attention to what may probably be a very useful application of the above properties of glycerine. I mean in cases where the aroma of the flower is so delicate as to be much injured, if not entirely destroyed, by the application of heat; when such is the case, the extraction of the perfume by glycerine may be substituted for the process of enfleurage as now carried on to such a large extent at Grasse and Cannes, and which is an extraction by fats.

The process would then become one of cold maceration, no heat being employed in the *bain*. After macerating the flowers for some considerable time in the glycerine, it is expressed, and again treated with fresh flowers until the excipient is thoroughly saturated with otto. The extraction seems perfect, as the glycerine evidently has a great affinity for volatile oils. The saturated glycerine is then diluted with water, and shaken with a small quantity of chloroform. After well agitating, the latter is allowed to subside; it carries down with it nearly the whole of the essential oil. This chloroform solution, after being separated by a funnel, should be filtered and allowed to evaporate spontaneously in a shallow vessel; the residual matter dissolved in spirit forms the spirituous extract of the flowers, whatever that may be. If operating upon large quantities it becomes desirable to economise; therefore, in such a case, the greater part of the chloroform may be drawn off in a still, the last portions being allowed to evaporate spontaneously. The boiling point is so low that even the most delicate perfume would hardly be deteriorated by the heat employed. Even the offensive smelling bisulphide of carbon, from its ready volatility, might be used, it being cheaper, but it must be quite pure or free from other sulphur compounds. The glycerine may be used over and over again by diluting, passing it through charcoal, and then evaporating it to the desired gravity.

As regards the application of glycerine to the preserving of leaves, &c., for distilled waters, I have myself practically carried it out with great success, having kept flowers for two years, and on opening them found not only the perfume natural, but the structure of the flowers without the least disorganisation.

I merely throw out these remarks on the process called enfleurage as a suggestion, as it could only be practically put to the proof at some place where the flowers are cultivated extensively. The great number of men and women required in that process as now carried on in the Var district would point out that a great saving would be made both in time and money by a method similar to the above. Another object is, that although there are large growers at those localities, the mass of the flowers are grown by cottagers, and collected from them by *commissionaires*. In the above plan the flowers could be placed in perfect safety as brought in, and by this means all danger from heating by fermentation is thrown out of consideration. I have extracted on a small scale and by the above means the aromata from heliotrope, wallflower, and other flowers.

|| Fresh mint suspended over a thin stratum of glycerine imparts in a short time a considerable odour to that fluid.

¶ There are annually grown at the district of the Var, 2,284,000 lbs. of flowers for the process of enfleurage.

PROCEEDINGS OF SOCIETIES.

LECTURES ON CHEMICAL PHILOSOPHY.—V.

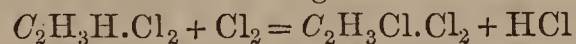
Delivered at the College of France; by M. A. WURTZ.

(Continued from page 201.)

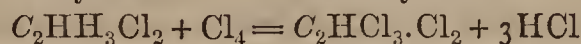
On Substitutions.

WE may distinguish three classes of facts relative to substitutions—1. The substitution of simple bodies for simple bodies; 2. The substitution of compound radicals for simple bodies; 3. The substitution of compound radicals for compound radicals.

As regards the substitution of chlorine for other simple bodies, we shall remark that the amount of chlorine which becomes active is always a molecule Cl_2 , or a group of molecules Cl_4 or Cl_6 , &c., but never an atom or an uneven number of atoms. The following reactions will show this:—



Chloride of ethylene. Chlorinated chloride of ethylene.

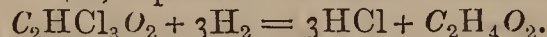


Chloride of ethylene. Terchlorinated chloride of ethylene.

These metamorphoses are double decompositions, double substitutions, in which the hydrogen and the chlorine are exchanged volume for volume, atom for atom, exactly as silver and sodium are substituted for one another in the reaction of chloride of sodium on nitrate of silver—

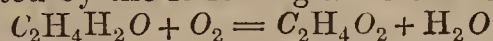


Further, a chlorinated substitution compound being given, we can reproduce the original compound also by a double decomposition. For example, Melsens, by acting on terchloracetic acid, $\text{C}_2\text{HCl}_3\text{O}_2$, with sodium amalgam in the presence of water, reproduced acetic acid—



Thus we see chlorine, and we may add bromine and iodine, replacing hydrogen volume for volume, atom for atom. This shows that the atoms of these different bodies are equal to one another, or possess the same value in substitutions.

Let us now examine some other cases of substitution: the reactions of oxygen on alcohol, for example. In this case there is the formation of acetic acid, which we can prove is effected by the following double decomposition:—

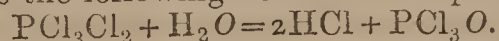


Alcohol.

Acetic acid.

In this reaction one atom of oxygen is substituted for two atoms of hydrogen, and this happens in all reactions; to replace one volume of oxygen, two volumes of hydrogen are necessary. We know, besides, that one atom of oxygen combines with two atoms of hydrogen to form the stable compound H_2O . We conclude from this that one atom of oxygen is equal to two atoms of hydrogen, or, in other words, that oxygen has a combining power and a substitutional value double that of hydrogen. Whilst one volume or one atom of hydrogen combines with one atom or volume of chlorine to form two volumes of hydrochloric acid, two volumes or atoms of hydrogen are required to form with one atom or volume of oxygen, two volumes of the vapour of water.

We can also substitute oxygen for chlorine, and we observe that it proves the following double decomposition:—



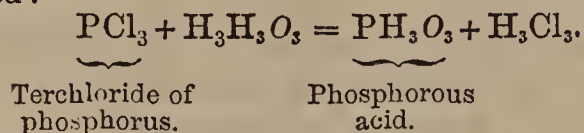
Perchloride of phosphorus.

Oxychloride of phosphorus.

Here we see that one atom of oxygen is equal to two atoms of chlorine, which in themselves are equivalent to two atoms of hydrogen.

Phosphorus furnishes us with another example of substitution; it takes the place of three atoms of hydrogen, is equivalent to three atoms of hydrogen. Thus, in the

formation of phosphorous acid, the following metamorphosis is effected:—



We arrive, then, at the following conclusions:—

1. That one atom of chlorine may be substituted for one atom of hydrogen, or is equal to one atom of hydrogen.

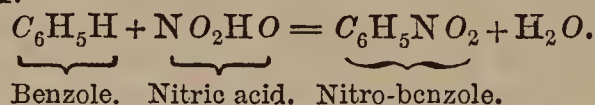
2. That one atom of oxygen may be substituted for, and may combine with two atoms of hydrogen, or is equivalent to two atoms of hydrogen.

3. That one atom of phosphorus may be substituted for, and combine with three atoms of hydrogen or is equivalent to three atoms of hydrogen.

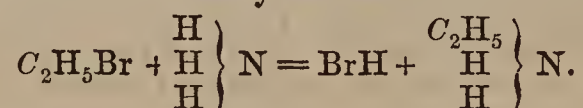
With chlorine we may class bromine, iodine, and fluorine; with oxygen, sulphur, and selenium; with phosphorus, nitrogen, &c. To the elements belonging to the first group we give the name *monatomic* since their substitutional value or combining power is equal to 1; those of the second group we call *diatomic*, since their value is equal to 2; and those of the third we name *triatomic*, for the reason that their value in substitution is equal to 3.

We shall see by-and-by that we can rise still higher, and we shall have to unfold the history of *tetra-* and *penta-*atomic elements.

Let us pass to the substitution of compound radicals for simple bodies. One of the first examples of such a substitution we meet with is that of the formation of nitrobenzole by the action of nitric acid on benzole. In the metamorphosis we have the substitution of the group NO_2 for H .

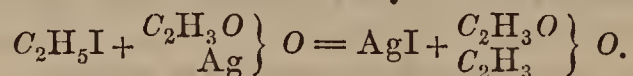


An analogous double decomposition takes place in the reaction of bromide of ethyl on ammonia:—



A reaction which shows the atomic equivalence of hydrogen and the group C_2H_5

The formation of acetate of ethyl is similar:—



Here we see that an organic group is substituted for the metal Ag. There are then organic groups (NO_2 , C_2H_5), which substitute themselves for and combine with one atom of hydrogen. These groups are comparable to the monatomic elements, and we shall call them *monatomic radicals*.

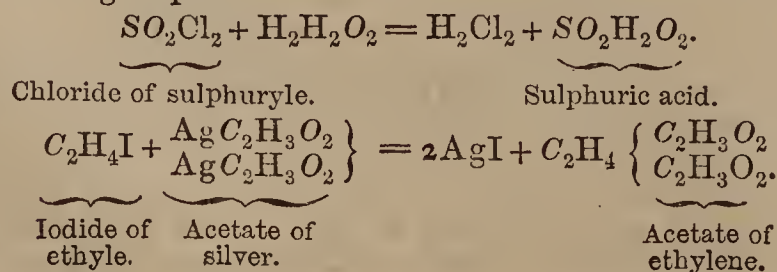
There are also polyatomic radicals. Thus, if we mix chloroxycarbonic gas with water, the group CO is substituted for H_2 .



Thus CO , which combines with Cl_2 , may be substituted for the H_2 of the water. The combining or substitution value of the group CO is double that of H , equal to H_2 ; the group then is diatomic.

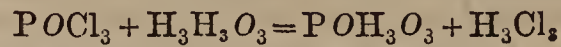
Let us notice in passing that this similarity of action and atomicity which we discover to exist between the mineral elements and the organic compound radicals contributes greatly to bring together the two chemistries.

The following equations show some other examples of diatomic groups:—



In the first reaction we see the diatomic group sulphuryle SO_2 (sulphurous acid) substituted for H_2 ; in the second, the diatomic group C_2H_4 substitutes itself for 2Ag in the two molecules of acetate of silver, and binds together the remaining elements of these molecules.

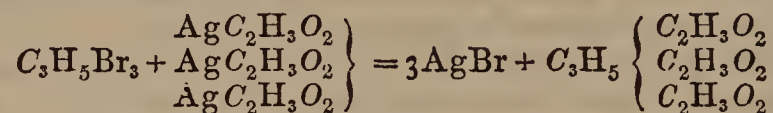
Lastly, we arrive at triatomic radicals, that is to say, groups which may be substituted for H_3 . The formation of phosphoric acid gives us an example of such a substitution.



Chloride of phosphoryle, or, oxychloride of phosphorus.

Here we see the group PO substituted for H_3 .

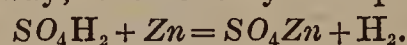
The production of Berthelot's triacetine furnishes us with another example:—



The group C_3H_5 is here substituted for 3Ag , which are the atomic equivalents of 3H ; thus the group C_3H_5 , like the group PO , is triatomic.

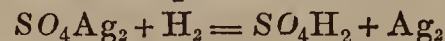
The varied illustrations which we have given, and chosen designedly from mineral as well as organic chemistry, show us that there elements and groups possessing different atomicities; that is to say, that the various elements do not always replace each other atom for atom, nor the various groups molecule for molecule.

Fully comprehending the importance of this idea of the fact of double substitutions introduced by Dumas and Laurent, Gerhardt insisted that all chemical changes are double decompositions. This was going too far; there are simple substitutions. Thus, when we prepare hydrogen in the ordinary way, it is done by a simple substitution:



The molecule of zinc we know is not double; but the atom of zinc (=65) can exist alone and play the part of H_2 .

The decomposition of sulphate of silver by hydrogen is another example of a simple substitution:



In the explanation of all these reactions you have seen, gentlemen, that we have often introduced the word radicals; in an early lecture we shall indicate the exact meaning which we attach to this word.

NOTICES OF BOOKS.

First Outlines of a Dictionary of the Solubilities of Chemical Substances. By FRANK H. STORER. Part III. London: Trübner and Co. Cambridge (U.S.): Sever and Francis. 1864.

THE present part completes this valuable work, and we must highly commend the industry of the author who has brought it so quickly to a conclusion. The amount of reading which its compilation required must have been enormous, as will be seen by the innumerable references in its pages. But the author has bestowed more than mere literary labour on the work, for we occasionally come upon original experiments undertaken to reconcile or decide between the conflicting statements of different authorities, which give an additional value to the book.

The modest title which the author has given to the work may perhaps convey a false impression to a reader who sees only the title. Although denominated "First Outlines of a Dictionary," it is, in fact, exhaustive up to the date of publication. The number of "chemical substances" of which the solubilities are here given we have not had the patience to enumerate, but we may say that the work consists of 713 large octavo pages closely printed in double columns. Looking to the future, the author sees that the number of chemical substances may be indefi-

nately extended, and thus the work which he has planned, and so far so successfully completed, will in progress of time become merely the outlines of a book, the size of which we are afraid to contemplate.

In a work of this kind, though so full of instruction, there is nothing to quote, and we must content ourselves with strongly recommending it. There is a class of books of which it is said that no library should be without them; and of this one we may say that it is pre-eminently one which should be found in the library of every practical chemist.

Journal für Praktische Chemie. October, 1864.

THIS journal opens with a paper by Dr. Winkler "On a Volumetric Process for Estimating Cobalt in the presence of Nickel." The author first estimates the cobalt and nickel together, by Künzel's process; then adds to another portion of the original solution (chlorides of the metals) some moist mercuric oxide, and afterwards a standard solution of permanganate of potash. Hydrated oxides of cobalt and manganese are precipitated, and the permanganate, of course, is decolorised. No change takes place with the nickel. The process is delicate enough to recognise one part of cobalt in 1000 of nickel. We shall give a detailed account of this method in an early number.

The next article is a description of an elaborate "Analysis of one of the Homburg Springs," by Fresenius, which may be taken as a model for an analysis of the kind, although there is nothing new in the method. All the calculations for the combinations of the ingredients are given, which will make the article valuable to a student.

Another useful article is by Clasen "On the Estimation of Tin and Antimony." The author has found Mr. Tookey's method does not give closely accurate results unless the amount of tin is greatly in excess of that of the antimony, in consequence of the solution of some of the precipitated antimony in the acid. He therefore recommends that a weighed quantity of tin should be added and afterwards subtracted from the amount found in the analysis. The precipitation of the antimony should be effected by thin pianoforte wire, which leaves no weighable deposit on solution in hydrochloric acid. The precipitated antimony may then be washed with hot acidulated water, and quickly dried and weighed to avoid oxidation.

Reich and Richter contribute a farther account of "Indium," which we shall translate, merely stating now that they have determined the atomic weight of the new metal to be (1) 463.4, (2) 458.4, (3) 464.9, O = 100. The methods employed seem to have been very rough, and the results are not very concordant.

The other papers in the *Journal* have already appeared in the CHEMICAL NEWS, with the exception of a notice of the methods of testing indigo, which shows that the oxidation processes are not to be relied upon.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2342. Alexander Horace Brandon, Rue Gaillon, Paris, "Improvements in machinery for refining petroleum and other oils." A communication from William Porter Downess, New York, U.S.A.—Petition recorded September 23, 1864.

2393. Coleman Defries, Houndsditch, London, "Improvements in lighting and ventilating."—Petition recorded September 25, 1864.

2409. Charles Godfrey Gumpel, Leicester Square, Middlesex, "Improvements in anatomical or surgical appliances for the support of parts of the human body."

2410. William Henry Gravely, Upper East Smithfield,

Middlesex, "Improvements in steam machinery and seawater distilling apparatus, all for use on board ship."

2411. Richard Archibald Brooman, Fleet Street, London, "Improvements in rendering soluble blue, violet, and red colours in crystals derived from aniline, toluidine, naphthaline, naphthylamine, and phenic acid."—A communication from Alcide François Poirrier, Montmorency, France.

2413. John Johnson, Runcorn, Cheshire, "Improvements in decomposing common salt with sulphuric acid in the manufacture of soda and muriatic acid."—Petitions recorded September 30, 1864.

2420. Edward Loysel, Park Place, Middlesex, "Improved apparatus for obtaining extracts from tea, coffee, and other vegetable substances."—Petition recorded October 1, 1864.

2428. Richard Archibald Brooman, Fleet Street, London, "The manufacture of a substitute for albumen."—A communication from Charles Kestner, Thann, France.—Petition recorded October 3, 1864.

2432. Richard Laming, Priory Road, Kilburn, Middlesex, "Improvements in making ammoniacal preparations."

2443. John Johnson and Thomas Johnson, Runcorn, Cheshire, "Improvements in purifying resin and resinous substances."—Petitions recorded October 4, 1864.

Notices to Proceed.

1387. Bondy Azulay, Rotherhithe, Surrey, "Improvements in treating petroleum and its products, and in the application of apparatus for that purpose."—Petition recorded June 4, 1864.

1409. Edward Joseph Hughes, Manchester, "Improvements in dyeing and printing."—A communication from Charles Lanth, Paris, France.—Petition recorded June 7, 1864.

1434. John Onions, Union Street, Southwark, "Improvements in the manufacture of iron and steel."

1438. Napoleon Sarony, Birmingham, Warwickshire, "Improvements in the production and treatment of photographic portraits or pictures."—Petitions recorded June 9, 1864.

1442. Josiah Pemberton Williams and Thomas Robinson, Widnes Dock, near Warrington, Lancashire, "Improvements in annealing wire."

1447. Charles William Siemens, Great George Street, Westminster, "Improvements in apparatus for producing combustible gases, part of which improvements are applicable for indicating the pressure of gases and fluids generally."—Petition recorded June 10, 1864.

1456. William Sharp, Bingley, Yorkshire, "Improved means, or apparatus for purifying and increasing the illuminating power of gas."—Petition recorded June 13, 1864.

2126. John Lones, West Bromwich, Staffordshire, "Improvements in coating iron with steel."—Petition recorded August 30, 1864.

2269. Charles Attwood, Tow Law Iron Works, Durham, "Improvements in blast furnaces."—Petition recorded September 16, 1864.

2316. George Scott, jun., St. Helens, Lancashire, and James Tudor, Weston, Cheshire, "Improvements connected with the manufacture of salt cake."—Petition recorded September 21, 1864.

2338. Walter Bentley Woodbury, Manchester, Lancashire, "An improved method of producing or obtaining, by the aid of photography, surfaces in 'relievo' and 'intaglio,' upon aluminous, vitreous, metallic, or other suitable materials."—Petition recorded September 23, 1864.

2364. Henry Beninson, Burrage Road, Plumstead, Kent, "Improvements in fluid meters."—Partly a communication from Frederick Arundel Downing, Hobart Town, Tasmania.—Petition recorded September 27, 1864.

CORRESPONDENCE.

On the Use of Sewage.

To the Editor of the CHEMICAL NEWS.

SIR,—Allow me to say a word or two on this subject. Having read Baron Liebig's letters bearing on this matter, I fully agree with the learned Baron on most points. I may, however, perhaps be allowed to have opinions of my own. It would appear that many chemists try to make out that our British farmers know little or nothing of the use of manures. I have no wish to appear as champion for any party, but I do believe that no sensible farmer—and there are many in our little island—would ever think of using sewage as a permanent manure. Surely it is not required of the farmer that he should make a profound analysis of sewage before using it. Has it not been used long before the important question of the use of sewage was brought so prominently before the public? I should imagine its properties are pretty well known by farmers ere this. There need be no fear that they will make a monopoly of it as a manure, and bring about such lamentable results as is feared. To bear out my views, look at the quantity of artificial manure that is made and sold in England every year.

When at Northampton some years ago, a gentleman by whom I was employed rented the sewage works of that town, and converted it into an artificial manure manufactory. All the sewage which came into the works from the town was made into various manures. It was not sent out in its original state, but at a trifling cost was made to suit almost all crops. Many hundred tons were disposed of to the farmers every season; and it answered in an extremely satisfactory manner. I merely mention this fact to show that sewage has been long before this brought to a good account—at one place, at any rate. I see no difficulty in doing what Baron Liebig puts forth in the last paragraph of his letter in the CHEMICAL NEWS of the 22nd instant. In fact, it has been done, to a certain extent, in the case above mentioned. I do not question any statement of the Baron's, but think the matter only requires more attention to enable our farmers to make a good use of sewage matter.

I am, &c.

J. H. S.

Bow, October 25.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—"Isolation of the Electro-negative Radicle Valeryl," by Professor Wanklyn. "Existence of Nitrogen in Steel," by Messrs. Graham, Stuart, and Baker. "Concentration of Nickel in Lead by Pattinson's Process," by Mr. W. Baker. "Effect of Ignition on Garnets, &c.," and "Colouring Matter of Certain Rocks," by Professor Church.

University of Edinburgh.—In consequence of Dr. Playfair's absence from England, the information relative to the Chemical classes at the University of Edinburgh has only just reached us. As the Scottish schools open in November the information may still be of use to some reader. The course of instruction consists—

1. *Of Lectures.*—In the course of lectures the general subjects of theoretical chemistry, including a detailed description of elementary bodies and their compounds, are considered with especial reference to their useful applications to medicine and the industrial arts. The subjects of chemical physics are also fully discussed in their bearing on the general laws which govern the union of the different bodies. Examinations of the students, both oral and written, are frequently held. The Chief and Second Assistant conduct tutorial classes in connexion

with the lectures, in order to discipline the student on the subjects treated of.

2. *Laboratory.*—The laboratory is open for the reception of pupils who desire to study analytical chemistry, or to undertake chemical investigations. The Hope prize of the annual value of £50, is awarded in four laboratory scholarships to the four most successful students of the general class. The fee for the laboratory is ten guineas for six months, or six guineas for three months. It is open during all the winter session, and for three months in the summer session. The Professor is aided in the laboratory by Mr. Dittmar as Chief Assistant.

3. *Practical Classes.*—The instruction in these is chiefly devoted to practice in qualitative analysis, with the view of enabling the student to test unknown substances, poisons, urine, &c. They are taught by the Demonstrator, Dr. Dalzell, under the superintendence of the Professor. The fee is three guineas.

Text-books.—Any of the following, viz.:—Fowne's Manual of Chemistry: Churchill, London. Gregory's Hand-book of Chemistry: Taylor and Walton, London. Miller's Elements of Chemistry. 3 vols. Parker and Sons, London.

The New Hydrocarbon Light.—In our previous account of Mr. Bowditch's invention we were obliged to omit all notice of the interesting lecture that gentleman delivered in explanation of his invention. In the course of it he referred to the ordinary constituents of common gas, and showed from Bunsen's analyses the great predominance of heat-producing over light-giving ingredients. Passing to a consideration of the nature of flame, he showed that the higher hydrocarbons generated from coal which give the maximum of light were excluded from gas by the fact of their assuming either the liquid or solid form at the ordinary temperature of the air. The object of his invention, he said, was to restore these hydrocarbons to the gas, and hence to obtain the maximum illuminating power, with the minimum of heat. The method by which the inventor vaporises naphthaline, &c., we explained in our previous notice. Mr. Bowditch conjectures that in a state of vapour and at a high temperature some chemical combinations take place between the several vapours and the constituents of the gas, combinations which break up again at a lower degree of heat. The grounds for this belief were not fully stated, and we may omit all notice of them for the present. With regard to the increase of illuminating power obtained, the extract from the prospectus we quoted last week considerably understated the results. The experiments made and verified by ourselves proved that the light given by gas passing through the carburetter at the rate of three feet per hour was eight times greater than the light given by ordinary gas burnt under precisely similar conditions at the rate of three and a-half feet per hour. It is only fair, however, to the gas companies to say that the burners employed in the experiments were not the most approved for obtaining the maximum light from poor gas like that supplied in London. But the great advantage of the invention is no less apparent since the light is obtained at so little cost.

ANSWERS TO CORRESPONDENTS.

* * All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

A Subscriber.—We will inquire, and answer your question next week.

J. G. B.—We should not like to draw an inference from the experiment described.

P. C.—We do not know the process, but the acid is no doubt acetic, which only requires purification in the ordinary way.

Books Received.—Galloway's Qualitative Analysis, fourth edition; Elements of Materia Medica, by Dr. Wm. Frazer, second edition.

Received.—A. Reynolds, next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Revision of the Mineral Phosphates, by A. H. CHURCH, M.A. Oxon., Professor of Chemistry, Royal Agricultural College, Cirencester.

No. III.—PRASINE, &C.

A CAREFULLY selected sample of this mineral, from Libethen, Hungary, was finely ground, and then dried over oil of vitriol for five days. By this treatment 21·8 grains lost only ·03 of a grain. Submitted to analysis, prasine gave the following results:—

9·19 grains prasine gave 2·82 grains $Mg_3P_2O_7$.
9·19 „ „ „ 6·56 „ Cu_2O .
21·77 „ „ „ lost 1·92 „ H_2O (& CO_2) on ignition

These numbers, translated into percentages, are compared below with the theoretical percentages deduced from the formula $Cu_3PO_4, 3CuHO$:—

	Theory— $Cu_3PO_4, 3CuHO$.		Experiment.
Cu_2O . . .	238·5	70·87	71·16
P_2O_5 . . .	71·0	21·09	19·63
H_2O . . .	27·0	8·04	8·82
	336·5	100·00	99·61

The agreement of the experimental and theoretical numbers is not very close; experiment gave too little phosphoric anhydride and too much water. The cause of the discrepancy soon became apparent. Prasine contains variable quantities of malachite, the carbonic anhydride of which, at the same time that it lowers the percentage of P_2O_5 , raises that of water as deduced from the loss sustained on ignition.* The percentage of CO_2 was ascertained by dissolving a considerable quantity of prasine in hydrochloric acid in Parnell's apparatus. From the loss of weight the percentage of carbonic anhydride was first calculated, and then from this the corresponding percentage of malachite. Some specimens of prasine contained more malachite than others; while, as a general rule, the paler and softer interior layers of a specimen contained more than the darker and harder outer crust. The percentages varied between 1·05 and 6·97. We must, then, regard prasine as chemically identical with phosphochalcite—remarking, however, that it usually occurs more or less mixed with malachite. It is possible that just as chrysocolla is silicated malachite, so prasine is phosphated malachite; the physical appearance of these minerals strongly confirms this view.

If malachite had not been a proved constituent of prasine, I should have felt inclined to assume the formula $2Cu_3PO_4, 7CuHO$ for this mineral, since the percentage composition deduced from this formula approaches very nearly the experimental values, as the annexed numbers show:—

	Theory— $2Cu_3PO_4, 7CuHO$.	Experiment.
Cu_2O . . .	71·59	71·16
P_2O_5 . . .	19·39	19·63
H_2O . . .	9·02	9·21 (by difference)
	100·00	100·00

A Cornish mineral, apparently referable to phosphochalcite, was analysed by Heddle† in 1855. He, however, found too much phosphoric anhydride (22·73 per cent.), and too little cupric oxide (68·13 per cent.) He likewise found ·48 per cent. of silica.

Several other substances besides silica and malachite have been detected in specimens of phosphochalcite and the allied minerals. Bödecker‡ discovered selenium in some samples from Rheinbreitbach; Bergmann§ found arsenic (1·78 per cent. As_2O_5) in a phosphochalcite from Linz, on the Rhine; while in the allied mineral species ehrlite he detected as much as 7·34 per cent. of vanadic anhydride.¶ But all the analyses point distinctly to the formula $Cu_3PO_4, 3CuHO$ as representing the normal constitution of the mineral under consideration.

The formulæ of most of the allied mineral cupric phosphates are sufficiently well made out. The following list gives the names and formulæ of the more distinct kinds of these mixed phosphates and hydrates of copper. In all cases the analytical results obtained by the various chemists who have analysed them agree closely with the theoretical values, otherwise I should have thought it likely that the percentage of water in pseudolibethenite, ehrlite, and perhaps in tagilite had been determined in specimens which had not been properly dried:—

Libethenite— $Cu_3PO_4, CuHO$.

Pseudolibethenite— $2Cu_2PO_4, aq., 2CuHO$, or (?) $Cu_3PO_4, CuHO$.

Tagilite— $Cu_3PO_4, aq., CuHO$, or (?) $Cu_3PO_4, CuHO$.

Dihydrate— $Cu_3PO_4, 2CuHO$.

Ehrlite— $2Cu_3PO_4, aq., 4CuHO$, or (?) $Cu_3PO_4, 2CuHO$.

Excluding the aq. in the three minerals I have named above, and introducing for comparison the formula of prasine and phosphochalcite, we obtain the following series:—

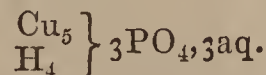
$Cu_3PO_4, CuHO$ —Libethenite, pseudolibethenite, and tagilite.

$Cu_3PO_4, 2CuHO$ —Dihydrate, ehrlite.

$Cu_3PO_4, 3CuHO$ —Prasine, phosphochalcite.

Not having been successful as yet in procuring satisfactory specimens of tagilite, &c., I have been unable to test further the soundness of the proposed formulæ, so far as regards the exclusion of the water. In one or two of the published analyses, the water, though probably determined by loss merely, was below that demanded by the old formula.

As to thrombolite, an amorphous mineral analysed by Plattner, its generally-received formula has merely to be re-arranged to become—



Synthesis of Amylglycol by Oxygenated Water and Amylene.

OXYGENATED water, in hydrochloric solution, as much concentrated as possible, reacts readily on amylene. This body disappears after a few weeks, if frequently shaken, and there remains a strong odour of hydrochlorate of oxide of amylene, which ether will remove from the liquid. If the liquid is then freed from hydrochloric acid by oxide of silver, and evaporated in a vacuum, there remains a thick liquid, with a pungent odour, which is amyglycol. In fact, treated by subchloride of sulphur, it is converted into hydrochlorate of oxide of amylene, which possesses the property and composition of this body. This experiment puts beyond doubt that oxygenated water can directly fix on carbides of hydrogen to form glycols or diacid alcohols.



Amylene.

Amyglycol.

—*Annales de Chem. et de Phy.*, l. 492. 64.

* Malachite contains 71·94 Cu_2O , 19·91 CO_2 , and 8·15 H_2O per cent.

† *Phil. Mag.*, (4) x., 39.

‡ *Ann. Ch. Pharm.*, xciv., 356.

§ *Pogg. Ann.*, civ., 191.

¶ *Jahrb. Min.*, 1858, 19.

On the Separation of Titanic Acid and Zirconia,
by M. F. PISANI.

THE separation of titanic acid and zirconia is undoubtedly one of the greatest problems in analytical chemistry; in fact, the difficulties of all kinds by which it is surrounded are so great that no certain method has yet been found, in spite of the progress in modes of analysis for most chemical bodies; moreover, since Berzelius, all analytical treatises are unanimous in saying that absolutely nothing is known on this subject. Titanic acid and zircon, which separately may be estimated with the greatest accuracy, when together present such properties that it might be said one of these two bodies had partly destroyed the individuality of the other, since the reactions they possess when separate they no longer possess together, and in some cases they act quite different. Thus, it is well known that titanic acid in the state of sulphate is completely precipitated by boiling in a diluted liquid, and that when in presence of zircon there may, according to the proportions of the two bodies, be either incomplete precipitation or not at all. Moreover, precipitated titanic acid always retains zircon, of which the greater part remains in solution with the rest of the titanium. Not having been able, in spite of long researches, to effect the separation of these two bodies with sufficient accuracy, I found a way of independently estimating titanium, and so indirectly determining the zircon. The following is the foundation of this method:—

A solution of titanic acid in sulphuric or hydrochloric acid is reduced by zinc to the state of sesquioxide of titanium, giving a liquid of a more or less intense violet colour. In this state titanium is a very powerful reducer, On pouring permanganate of potash in this liquid, titanic acid is formed, and the solution gradually loses its colour until it becomes rose. According to the quantity of permanganate of potash it is found necessary to add may be calculated the quantity of titanic acid, taking for each equivalent of iron to which the permanganate corresponds one equivalent of titanic acid.* The following is the mode of operating:—

Titanic acid in solution in hydrochloric acid is best, because if in the state of sulphate it is liable to be partially precipitated by the rising of the temperature, before its complete reduction has been effected. In this case the sulphuric liquid should be precipitated by ammonia, the precipitate washed by decantation, and redissolved in hydrochloric acid. The reduction should be effected in a phial, to which has been adapted a cork with a drawn out tube, so as to keep the liquid from contact with the air. The quantity of liquid should not be great, and should be acidified until the disengagement of hydrogen becomes regular; then heat gently to accelerate the reduction, and when the colour of the liquid ceases to increase in intensity, leave it to get quite cold and dilute the liquid with cold water, which has been previously boiled to free it from air, as it would otherwise oxidise the titanium. As soon as the liquid is diluted decant it into a glass without taking the zinc with it, wash the flask once or twice, and then rapidly pour in the permanganate of potash.

Titanic Acid and Zircon.—First determine the weight of the two bodies, then after having attacked them by bisulphate of potash or sulphuric acid, estimate the titanium as above, the difference giving the quantity of zircon.

Titanic Acid and Iron.—The iron having been reduced by zinc before the titanium, and then reduced by the permanganate, I have adopted the following method of estimating these two metals at the same time. Pour permanganate upon them until the violet colour disappears, thus finding the moment at which the iron begins to oxidise in its turn by taking from time to time a drop of the liquid and mixing it with a drop of sulpho-cyanide of potassium in a porcelain capsule. When the sulpho-cyanide begins to be coloured the number of divisions used will give the quantity of titanic acid; the operation may then be continued for estimating the iron. Another method I have employed consists in reducing the iron by sulphuretted hydrogen or sulphite of soda, which does not act on the titanic acid, and then estimating the iron after having freed the liquid from the excess of sulphuretted hydrogen or sulphurous acid in the way usual in such cases. The difference gives the amount of titanium, but as the results often give too large a quantity of iron the first method is much preferable.

Titanic Acid, Zircon, and Iron.—Weigh the three bodies; attack them with bisulphate of potash, and estimate the titanic acid and the iron by means of the first method; the difference gives the amount of zircon.

A curious fact I have remarked is that if fluotitanate of potash or titanic acid is reduced by zinc in hydrochloric acid to which an alkaline fluoride has been added, the liquid is no longer violet, but greenish, probably because a sesquifluoride of titanium is then formed instead of a sesquichloride. However, the results of the estimation by permanganate are the same in this case.

The above will show how easy it is to estimate titanic acid mixed with zircon; also in most analyses in which titanic acid is precipitated by boiling, it may by this means be ascertained whether it is free from other bodies. When it contains zircon a second estimation of titanic acid is necessary in the liquids not precipitated by the boiling and containing the rest of the zircon with the other bases. For this it is necessary to separate the zircon, the titanic acid, and the iron, to weigh them together, then to determine the quantity of titanium and iron, the difference giving the amount of zircon.

I have used the following methods for ascertaining directly the presence of zircon when mixed with titanic acid:—

1st. A solution of zircon in hydrochloric acid colours tumeric paper orange, especially after it has been left to dry, and titanic acid under the same circumstances colours it brown, which prevents zircon from being recognised. I have overcome the difficulty by reducing the titanium by zinc, which in the state of sesquioxide does not colour tumeric paper, leaving the colour of the zircon to appear alone. Nevertheless, the paper must not be left too long to dry in the air, for the titanium, passing into the state of titanic acid, would in its turn colour it brown.

2nd. Titanic acid and zircon are precipitated equally by sulphate of potash; but if the titanium is previously reduced there remains only the zircon to be precipitated. Add excess of sulphate of potash to the violet liquid, which should be small in quantity and not too acid, the zinc being still slowly attacked meanwhile; leave to stand for some time, then filter quickly and wash the precipitate with a solution of sulphate of potash, then extract the zircon by the usual processes. Once in solution in hydrochloric acid its presence may be ascertained by means of turmeric, and by reducing by zinc it will be found that only a trace of titanium remains. I have

* The permanganate should be estimated by means of iron by Margueritte's process.

not yet, however, succeeded in effecting this separation quantitatively.

I have applied the same process to the estimation of titanio acid in molybdene, obtaining very exact results. With tungsten in niobium and vanadium my experiments have not at present been so satisfactory.—*Comptes Rendus*, lix., 298, 64.

On some Anomalies in the Detection of Sulphuric Acid,
by JOHN SPILLER, F.C.S.

WHILST making an analytical examination of several samples of commercial phosphoric acid, I have been led to the discovery of a remarkable case of interference which appears to have hitherto escaped observation.

On mixing an aqueous solution of glacial phosphoric acid with chloride of barium for the purpose of testing for sulphuric acid amongst the impurities likely to be present, I found that, although no immediate precipitate made its appearance, the solution became gradually turbid, and eventually a very distinct indication of the existence of sulphuric acid was observed. This anomaly led me to examine further the reaction in question, and by now mixing intentionally the sulphuric and phosphoric acids, the fact already alluded to became sufficiently apparent.

As the result of a few experiments upon this point, it was proved that, if to an aqueous solution of the glacial acid a small proportion of sulphuric acid be added, the mixed liquid did not give the usual indication of a precipitate on adding a few drops of chloride of barium, but required a liberal addition of the last-named reagent in order to induce the formation of the sulphate. By adding dilute hydrochloric acid, or by raising the temperature of the clear barytic solution, the formation of a precipitate was determined; but continued ebullition failed, in many instances, to separate the whole of the sulphate of baryta. When, however, by the action of heat and of hydrochloric acid conjointly, the white precipitate made its appearance, it was always found to be markedly different in physical character from the product usually obtained. It was thrown down in the form of a semi-transparent flocculent precipitate, very like that formerly obtained by me through the intervention of an alkaline citrate, as described in my paper entitled "On the Influence of Citric Acid on Chemical Reactions," which was read before the Chemical Society on March 16, 1857*.

This remarkable property of obscuring the indication of sulphuric acid appears to be possessed only by the glacial modification of phosphoric acid; for, if the white flakes of phosphoric anhydride (as obtained by the combustion of phosphorus) be dissolved in water, no such result is apparent; nor do the hydrochloric acid solutions of bone-ash and of the ordinary phosphate of soda mask, in any appreciable degree, the presence of sulphuric acid. But if by heat the ordinary crystals of phosphate of soda be converted into pyro-phosphate, and then dissolved in dilute hydrochloric acid, a solution is obtained which in this particular exactly resembles the glacial modification of phosphoric acid.

As in the case of the citrates, there appear to be several reactions which are altogether modified by the presence of the glacial acid. It is well known that many metallic oxides form combinations with phosphoric acid, which differ widely in character from the ordinary saline compounds of the same metals; iron, particularly, is in

this category, and I find that the salts of lead, like those of barium, fail in giving any precipitate with diluted sulphuric acid, in which has been dissolved a fair proportion of the glacial phosphoric acid.

Chemical Department, Woolwich, October 25.

On Indium, by F. REICH and T. H. RICHTER.

A QUANTITY of black blende ore from the Himmelfahrt mine, weighing 200 lbs., on treatment with hydrochloric acid and subsequent evaporation gave about 43 lbs. of impure chloride of zinc, which, after treatment with water, left a residue containing indium, from which a few grammes of the new element were obtained. The metal can be reduced from the oxide by fusion in a carbon crucible with carbonate of soda and borax, and refusion with cyanide of potassium. By fusing with the cyanide alone the oxide is reduced, but only to a metallic powder. The density of two specimens, weighing respectively 327 and 343 milligrammes = 7.11 and 7.147; a rolled leaflet of 415 milligrammes gave a density of 7.277 at 20.4° Cent. The colour of the metal is between tin and silver white. It is exceedingly soft and very ductile, and retains its metallic lustre when exposed to the air or in water, even when boiled. The fusing point is about the same as that of lead. Hydrogen reduces the oxide to a metallic powder, which cannot be fused in the bulb tube. On charcoal before the blowpipe it fuses easily, colouring the flame blue, and covering the charcoal with a coating, which is dark yellow while hot and white when cold. This coating is volatilised with difficulty when treated directly with the blowpipe flame. The oxide imparts no colour to the fluxes; when fused with borax it gives a grey enamel; with salt of phosphorus and tin a grey pearl. The metal is slowly dissolved by hydrochloric and sulphuric acids when cold, with evolution of hydrogen; heat increases the rapidity of the solution. It dissolves rapidly in nitric acid, even when cold and diluted. The hydrated oxide is completely precipitated from the acid solutions by ammonia and potash; the presence of tartaric acid prevents this precipitation. A solution of the metal in nitric, sulphuric, or hydrochloric acids gives no precipitate with sulphuretted hydrogen; but when dissolved in acetic acid it is precipitated completely as sulphide of indium, which is of a fine yellow colour, that on drying becomes nut brown, and when pulverised an orange colour. The chloride is obtained by passing dry chlorine over the heated oxide. It is very volatile, and condenses in the cold part of the tube in white scaly crystals, which are easily resublimed, and in that way procured of a larger size. The aqueous solution of the chloride decomposes on evaporation hydrochloric acid, some chloride volatilising, and oxide or a basic chloride remaining behind. The sulphate crystallizes with difficulty in small white scales. Carbonate of soda throws down from acid solutions a crystalline granular carbonate of indium, of a white colour. Solutions of the neutral salts of indium give a white precipitate with ferrocyanide of potassium, but none with ferridcyanide. The most striking property of the new metal, and the one which led to its discovery, is the indigo blue line which it shows in the spectroscope. This is also given by all the compounds of the metal thus far investigated. The chloride gives the most brilliant effect, but the sulphide is the more lasting. Indium compounds colour the flame of an ordinary Bunsen's burner blue.

To determine the atomic weight the pure metal was dissolved in nitric acid, the oxide precipitated by ammonia, and weighed.

* See also CHEMICAL NEWS, vol. viii., p. 280.

(1) 0.5135 of the metal gave 0.6243 of oxide, according to which $\text{In} = 463.4^*$.

(2) 0.699 of the metal gave 0.8515 of oxide, according to which $\text{In} = 458.4^*$.

We prefer the first determination, because the oxide in the latter was probably contaminated with iron.

From the solution of an unweighed quantity of well-washed, moist sulphide in nitric acid 0.2105 grm. of oxide of indium and 0.542 grm. of sulphate of baryta were obtained. This amount of sulphate of baryta corresponds to 0.0746 of sulphur, which gives ($\text{S} = 200$), $\text{In} = 464.9$.

We also endeavoured to determine the atomic weight by reducing the oxide in hydrogen; but the results were not sufficiently concordant to be useful. From the volatility of indium it might have been expected that the atomic weight obtained in this way would come out too low. That it always came out too high may be ascribed to the circumstance that the metal on fusing enveloped some oxide, and so prevented the reduction of the whole.

The method of extracting indium from the blende has been shortly described above, but a more detailed description may prove of service.

Finely powdered blende is dissolved in nitric acid and the solution treated with sulphuretted hydrogen. In this way copper, lead, arsenic, tin, cadmium, and molybdenum are precipitated, and then separated by filtration. The filtrate is afterwards treated with a large excess of ammonia, by which the greater part of the zinc is separated in solution, and oxide of indium and other metals precipitated. The washed precipitate is now dissolved in acetic acid, and this solution again treated with sulphuretted hydrogen, whereby sulphide of indium, contaminated with some sulphides of iron, zinc, and manganese, is thrown down. This precipitate is dissolved in hydrochloric acid with a little nitric acid, excess of ammonia is again added, and the precipitate rapidly filtered and washed. It is advisable to repeat this operation in order to remove the last traces of zinc and manganese. On dissolving this second precipitate in acetic acid, and treating the solution with sulphuretted hydrogen, a beautiful yellow precipitate of sulphide of indium is obtained, which, however, still contains some iron. To separate this, the sulphide is again dissolved in hydrochloric acid, the solution oxidised with nitric acid, and now, by the careful addition of ammonia or carbonate of soda, a small quantity of indium oxide and the iron may be thrown down. The filtrate from this precipitate on the further addition of ammonia yields pure hydrated oxide; or, if treated with carbonate of soda at a boiling heat, gives a pure carbonate of indium.

The above shows that a process for estimating indium in a blende quantitatively is still wanted. By the means described we only obtained 0.1 per cent. from the *Himmelfahrt* blende.

All the zinc from the blende we have examined shows the presence of indium, and it is more easy to separate the new metal from the zinc than from the blende itself.

TECHNICAL CHEMISTRY.

On the Extraction of Yellow from the Green Commercial Alizarine, by M. E. KOPP.

GREEN commercial alizarine, free from purpurine, is the only raw material which can be advantageously used for the preparation of yellow alizarine on a large scale. For this purpose it is only necessary to exhaust with hot

alcohol or turpentine in a displacement apparatus, and to concentrate the alizaric solutions thus obtained. But the following process founded on the employment of schist or tar oil is, at the same time, simpler, easier, and more economical:—Boil dry green alizarine several times with purified schist oil, whose boiling point should be as near 150°C . as possible. As soon as the boiling ceases, the insoluble green matter readily collects and deposits itself. After a few minutes decant the hot schist oil, which will have dissolved a large proportion of yellow alizarine, a part of which, on the cooling of the liquid, is deposited in a crystalline state. As soon as the temperature of the oil is lowered to 100° , add a weak ley of caustic soda, and shake briskly. The ley dissolves all the alizarine, taking a bluish violet tinge, and the schist oil rises to the top, perfectly colourless, and ready, after decanting, to serve for another operation.

Draw off the lixivium charged with alizarine, and pour into it sulphuric acid diluted with water.

Yellow alizarine is immediately precipitated in voluminous flakes, which have merely to be collected on a filter, washed with cold water until all traces of acid have disappeared, and then dried.

The greenish-black matter, exhausted by several successive treatments with schist oil, and almost completely freed from alizarine, is left to drain in bags, and then pressed to expel most of the adhering oil, every trace of which is removed by exposure to the air or in a stove.

By treating it, when hot, with its weight of nitric acid, much diluted with water, it is transformed, with disengagement of carbonic acid and nitrous vapours, and the production of a little phthalic acid, into a yellow or brownish-yellow matter, very little soluble in water, very freely soluble in alkaline vapours, which it colours an intense vinous red, and which may be conveniently called xanthazarine.

Xanthazarine dyes wool and silk immediately, with or without a mordant; and also, but not so easily, cotton with a mordant. The tints are similar to those produced by yellow woods. Reducing bodies, such as sulphuretted hydrogen, stannous chloride, and hyposulphites, act energetically on xanthazarine, and transform it into a new red colouring matter.—*Comptes Rendus*, lix., 330. 64.

PHARMACY, TOXICOLOGY, &c.

On the Preparation of a Permanent Wine of Iron, by HARRY NAPIER DRAPER and JAMES WHITLA.†

WE have endeavoured to effect in a simple and practical manner an improvement upon the formula of the British Pharmacopœia for iron wine. The present formula is as follows:—

Take of tartrated iron . 160 grains.
„ sherry . . . 1 pint. Dissolve.

It has been pointed out by Squire that tartrated iron does not readily dissolve in sherry, which is already saturated with bitartrate of potash, and that, indeed, used in the above proportion, it will not all dissolve. We have not found this to be accurately the case. The potassio-tartrate readily dissolves in the wine, but part of it is almost at the same instant decomposed, forming a brown precipitate, which renders the solution thick and turbid. This decomposition is apparently due to the action of the bitartrate of potash contained in the wine and the separation of an acid tartrate of iron. If

* $\text{O} = 100$.

† Read at the meeting of the Pharmaceutical Conference.

solution of potash be added to neutralisation, the precipitate is at once redissolved and the solution becomes clear. In a mixture of spirit and water of the same alcoholic strength as the wine, the tartrate dissolves without any trace of this decomposition.

If, after solution of the tartrate, the wine be filtered, it will remain transparent for some time, but sooner or later it again invariably deposits, becoming turgid and unsightly.

In making these experiments it was soon observed that the action of solar light affected in a very marked degree the permanency of the preparation. Kept completely in the dark, the wine could be preserved for some time without precipitation, but if exposed to direct sunlight a deposit occurred in a few hours. In diffuse daylight the same change takes place more slowly. This is evidently due to the well-known deoxidising action of solar light upon organic salts of iron, and is not even, as regards the potassio-tartrate, an original observation, the fact having been pointed out more than twenty years since by Sir John Herschel (*vide* "Hunt's Manual of Photography," third edition, p. 54). By exposure to light an insoluble proto-tartrate is formed, and if the solar action be prolonged nearly the whole of the iron may be withdrawn from the solution. In attempting to produce a permanent iron wine several salts of iron were tried, but that which afforded the best results was the ammonio-citrate. A solution of this salt in sherry, in the proportion of one grain to each fluid drachm, is, in the first instance, perfectly transparent. If it be exposed to the light a precipitate is produced, as with the potassio-tartrate, but it is considerably less in quantity, and requires for its formation much more prolonged insolation. On the other hand, if excluded from light, the wine thus prepared will retain its transparency for an indefinite period.

A preparation, however, which required complete protection from light could scarcely be said to be permanent, and our next aim was to discover some means of overcoming this objection. As the precipitate had been ascertained to consist of a ferrous salt insoluble in the wine, it was evident that the addition of some substance which should prevent its precipitation by keeping it in solution would effect this purpose. After trial of several agents, we arrived at the conclusion that neutral citrate of ammonia was that best adapted to the requirements of the case. Many tentative experiments resulted in our being able to fix the proportion of this salt necessary to keep the wine transparent without imparting any disagreeable taste. The following formula affords a preparation which, in our opinion, leaves little to be desired:—

Ammonio-citrate of iron . . . 160 grains.
Crystalline citrate of ammonia 60 ,,
Sherry 1 pint. Dissolve.

The wine thus prepared will, of course, contain in each fluid drachm one grain of ammonio-citrate of iron and three-eighth grain of citrate of ammonia. It is perfectly transparent, has no disagreeable taste whatever, and may be exposed to diffuse daylight without incurring the least liability to deposition, or indeed undergoing any apparent change, except that it becomes somewhat darker in colour after a time. This change in colour is, of course, produced by the reduction of the iron salt, the alkaline citrate not preventing the deoxidation, but simply keeping the proto-salt in solution. While, however, the alteration in tint cannot be considered of any practical importance, it may be quite prevented by keeping the wine in opaque vessels. The direct action of sunlight

produces in this wine a precipitate after a considerable time, but this is a crucial test to which the preparation is not likely to be often subjected. However, if it were necessary to guard against even this cause of alteration, the increase of the proportion of citrate of ammonia would effectually do so, but it would be at the cost of rendering the wine somewhat unpalatable. Kept in an ordinary tincture bottle, and under the same conditions of light and temperature to which such preparations are usually exposed, a specimen prepared more than two months since remains without any sign of present or approaching alteration.

Dublin, September 12.

PHOTOGRAPHY.

Photographic Properties of some Haloids of Copper,
by M. B. RENAULT.

IN a previous note I described some properties of protochloride and of chloride of copper obtained by exposing copper wire to a disengagement of chlorine proceeding from a liquid capable of yielding this element. The analogy between the properties of chlorine, bromine, iodine, and next of fluorine and cyanogen, led me to investigate whether the four last bodies were not yet further allied, in the respect I have mentioned, to chlorine, in the analogous combinations which they might furnish with copper. The result of my experiments I will now give.

A copper plate plunged into a solution capable of yielding bromine, such as bromine dissolved in bromide of potassium, bibromide of copper, perbromide of iron, &c., becomes covered with a white crystalline layer, like that obtained in analogous cases with chlorine. This layer dissolves in chloride of sodium, is insoluble in chloride of potassium and chloride of barium; soluble in chloride of ammonium, ammonia, sulphate of ammonia, bromine dissolved in bromide of potassium, hyposulphite of soda, cyanide of potassium, diluted hydrochloric, sulphuric, and nitric acids (the corresponding chloride of copper is less easily dissolved in the two latter acids); insoluble in sulphite and sulphate of soda, and bromide of potassium.

Exposed to solar light*, the bromide alters rapidly, passes through all the tints of chloride, preserving, however, a more decided blue colour. Daguerreotype proofs may be obtained, with a finish limited only by that of the negative employed; the sensitiveness of bromide seems to be greater than that of the chloride. Moreover, the difference is more marked between the solubility of bromide altered by light and of unaltered bromide, in certain solvents. Thus hyposulphite of soda and chloride of sodium dissolve unaltered bromide, while diluted solutions of these reagents have very little effect on bromide blackened by the influence of the solar rays.† The operator must be on his guard against the fact that the solvent acting on unaltered bromide often takes with it, in a pulverulent but undissolved state, the layer of superficially altered bromide, and thus simulates a solution.

An insulated plate washed with distilled water gives no precipitate with ferrocyanide of potassium, but, like that which has been chlorised, becomes slightly turbid with nitrate of silver.

* Diffused light also acts, but more slowly, on the bromide.

† Bromide of copper proofs may then be fixed in a similar way to that employed for photographic proofs.

Iodide of Copper.—A copper plate submitted to the action of iodine † becomes covered with an equally white crystalline layer much less alterable by light than the corresponding chloride and bromide. After an hour or two of insolation, if the plate is dry, the outline of the negative is barely distinguishable. Under the same conditions chlorised and bromised plates alter extremely.

It is a remarkable peculiarity that if, after a proper period of insolation, the iodised plate is plunged into a solution, sufficiently diluted, of nitrate of binocide of mercury, the non-insolated portions of the plate turn brick-red, while those, on the contrary, which have undergone the action of the light take the colour of protoiodide of mercury. This characteristic reaction, together with some considerations on the amount of electricity disengaged in the combination of copper with chlorine, bromine, iodine, and fluorine to obtain compounds sensitive to the light, will probably enable me to determine their composition.

Iodide of copper, altered by light or not, is insoluble in chloride of sodium, nitrate of potash, sulphite of soda, bromide of potassium, and chloride of ammonium, soluble in ammonia, hyposulphite of soda, cyanide of potassium, hydrochloric acid, diluted sulphuric and nitric acids, and sulphate of ammonia; altered iodide is rather less soluble in the last reagent.

Fluoride of Copper.—The solution most suitable in fluorising copper is the bifluoride of this metal. The plate, exposed to the light after having been attacked by fluorine, blackens and becomes violet-blue, like the chlorided plate, but more slowly. Before insolation, the plate is greyish-white, proving that the compound formed is not a protofluoride of copper.

Altered fluoride is very little soluble in hyposulphite of soda, chloride of sodium, diluted sulphuric and nitric acids, and sulphate of ammonia; soluble in diluted hydrochloric acid and in ammonia.

Unaltered fluoride dissolves in hyposulphite of soda, chloride of sodium, diluted sulphuric, nitric, and hydrochloric acids, and in ammonia, but is slightly soluble in sulphate of ammonia.—*Comptes Rendus*, lix., 558. 64.

PROCEEDINGS OF SOCIETIES.

The Chemistry of Gas Lighting, by Dr. LETHEBY.‡

THE lecturer remarked that the object he had in view in the present instance was to take a rapid survey of the entire subject of the chemistry of gas manufacture. He did not intend to dwell particularly on any special set of facts; for although every branch of the subject was full of interest, and might well be made the basis of elaborate investigation, yet the time at his disposal would not permit of anything more than a general and very cursory examination of the whole question. He would endeavour, therefore, to gather up the broad principles of chemical knowledge in this department of industry, and indicate their directive tendency. He hoped at a future time to have the opportunity of examining in detail the several branches of the subject; and at the very commencement of the inquiry it would be interesting to know something of the origin of the material upon which, as gas manufacturers, they had to operate. The question which here suggested itself was—does chemistry throw any light upon the production of coal? There could be no doubt that it owed its origin to ligneous tissue; but how had it undergone those changes which had converted it into coal?

† The plate may be exposed to iodine vapours or to the action of a liquid capable of furnishing iodine; when it is moist the action is accelerated.

‡ Abstract of a lecture delivered at Manchester before the British Association of Gas Managers.

Chemistry had pretty fully investigated this subject, and had shown that the production of coal was clearly traced to the Eremacausis, or slow combustion of ligneous tissue; and in looking at the modes of oxidation of woody matter, it would appear that there were three ways in which it could be, and no doubt was, effected. In the first place, it was partly effected by an internal change in the wood itself, whereby the elements—oxygen and hydrogen—associated and formed water, leaving the carbon free. In the second place, it was accomplished by the agency of water, the elements of which combined with carbon to form carbonic acid and marsh gas; and thirdly, it was effected by the action of atmospheric oxygen slowly carried to the woody tissue by percolating water. All these changes were illustrated by diagrams and by specimens of wood in every stage of change from lignite and Bovey coal to anthracite.

Formation of Coal.

Oak wood	$C_{36}H_{22}O_{22}$
Oak humus	$C_{35}H_{20}O_{20}$
Another ditto	$C_{34}H_{18}O_{18}$
Brown coal	$C_{33}H_{21}O_{16}$
Another ditto	$C_{32}H_{15}O_9$
Cannel coal	$C_{24}H_{13}O$
Caking ditto	$C_{20}H_9O$
Anthracite	$C_{16}H O$

It was scarcely within the province of the present lecture to enter upon a detailed inquiry as to the best kinds of coal for the manufacture of gas, and he did not propose to say more than that the coal must be of that description called bituminous. But it was a matter of considerable importance to know whether any particular coal would yield a fair average proportion of gas without submitting it to minute analysis. In referring, therefore, to the varieties of coal which were best suited for the manufacture of gas, he directed attention to the rough test whereby the value of the coal might be estimated; as, for example, the specific gravity of the specimen, which should be close to 1.3, and the loss encountered when a given quantity of the coal (say 100 grains) was ignited in a close vessel. The quality of the residue or the coke was also an indication of the value of the coal for gas purposes; and the lecturer exhibited a diagram of the average, the maximum, and the minimum amounts of coke and volatile matter in all the leading varieties of coal.

But there were certain impurities in coal which it became necessary to recognise. The three principal were ash or mineral matter, sulphur, and water, each of which had a very important influence on the manufacture of gas. The normal proportions of these impurities were illustrated by a series of diagrams of the compositions of various gas coals.

Composition of Gas Coals.

	Sulphur.	Ash.	Coke.	Volatile Mats.
<i>Staffordshire—</i>				
Maximum	3.10	3.50	66.00	42.90
Minimum	0.80	0.75	57.10	34.00
Average	1.71	2.01	61.61	38.39
<i>Lancashire—</i>				
Maximum	3.04	14.40	66.09	48.90
Minimum	0.52	1.09	51.10	33.91
Average	1.53	4.71	58.67	41.33
<i>Newcastle—</i>				
Maximum	2.85	9.12	72.31	45.17
Minimum	0.71	2.14	54.83	27.69
Average	1.29	4.52	61.24	38.76
<i>Scotch—</i>				
Maximum	1.58	8.05	59.15	45.06
Minimum	0.38	1.96	54.94	40.85
Average	1.22	5.46	57.32	42.68
<i>Yorkshire—</i>				
Maximum	1.40	10.50	66.90	38.00
Minimum	0.75	0.80	62.00	33.10
Average	1.19	2.96	64.37	35.63

Welsh—	Sulphur.	Ash.	Coke.	Volatile Mats.
Maximum	2.30	7.55	88.23	41.58
Minimum	0.84	1.25	58.42	11.77
Average	1.09	3.66	64.37	35.63

The modes of estimating these impurities were also referred to; and, in speaking of sulphur in coal, the lecturer alluded to the importance of making a selection of coals as free from it as possible, for Parliamentary legislation was manifestly towards the growing desire of the public to have gas with a minimum amount of sulphur. The means of determining the proportion of sulphur in coal were pointed out, and were illustrated by experiment. But, said the lecturer, there is another important question connected with this impurity in coal; in how many forms does it exist there; and of these, which are the most pernicious? He stated that it might, to a small extent, be there in a free state; and that of the combined forms it was perhaps associated with organic matter, as well as with iron (bisulphide of iron), and with lime as gypsum. The relative importance of each of these forms was dwelt upon, and he spoke of the pyritic form as the most objectionable, because of its giving off its sulphur at that temperature which is most favourable for the production of bisulphide of carbon and sulpho-hydro-carbons, both of which are unabsorbable impurities. The effect of moisture as an impurity was next referred to, and the lecturer explained how, when it was being distilled from the interior of a charge, and came into contact with the protosulphide of iron which had already parted with half of its sulphur, the aqueous vapour decomposed the sulphide, and formed sulphuretted hydrogen and oxide of iron, thus adding to the cost of the preparation.

The lecturer then directed attention to the facts which had been ascertained in respect of the temperature best suited for the destructive distillation of coal. He remarked generally that the action of heat on organic matters was to disturb the existing equilibrium of affinities, and thus to give the elements an opportunity of arranging themselves into other and simpler groups. The order of the movement of the molecules of organic matter when subjected to heat was somewhat as follows:—After the hygrometric or physical moisture had been dissipated, oxygen was the first to start in the race of thermotic change. It combined with hydrogen to form water, with carbon to form carbonic acid, and with carbon and hydrogen to form acid and spirituous compounds, comparatively rich in oxygen, and which were mixable with water. Next to move, perhaps, was the hydrogen in its combination with carbon to form solid and liquid hydrocarbons of the nature of paraffin and paraffin oil and benzole, which were not mixable with water. At a higher temperature the nitrogen combined with hydrogen to form ammonia, and with carbon and hydrogen to form pyrogenous alkalis, and with carbon alone to produce cyanogen. At this temperature, also, the sulphur took hydrogen to form sulphuretted hydrogen, and then carbon and hydrogen to form the sulpho-carbo-hydrogens, and, lastly, with carbon alone to form bisulphide of carbon. Finally, gaseous hydrocarbons were freely produced; and during all the time of distillation many of the primary compounds, by coming into contact with the red-hot coke and with the sides of the retort, underwent change, and were converted into secondary products, as naphthaline, &c.

The temperatures at which these changes were effected had been tolerably well ascertained. Up to the temperature of 700° Fahr., little or no change was effected in the coal beyond the evolution of physical moisture. At the temperature of melting zinc (773° Fahr.), a little chemical moisture with an empyreumatic odour was produced. At 980°, which is a red heat just visible in the dark, water and fat oils—the paraffine series—begin to distil, but there is little or no gas. At 1500°, which is a cherry-red, gas of high illuminating power is copiously evolved, and spirituous oils rich in carbon also appear. At a full red

heat (1800°), and from this to incipient whiteness, permanent gases of poor illuminating power, as carbonic oxide, marsh gas, and hydrogen, and pernicious sulphur compounds, are freely evolved. Practically, therefore, it may be said that the best temperature for distilling common gas coals is a cherry red (1500°), and for cannel coals a full red (1800°).

In illustration of the difference of the products when cannel coals are distilled at a high and low temperature, Dr. Letheby alluded to the quality of the tar in the two cases. The tar produced at a high temperature was always heavier than water—specific gravity 1.12 to 1.15; it dried freely in the air by oxidation; it contained hydrocarbons with such an excess of carbon that they could not be burnt in a common lamp; they were almost totally destroyed by strong oil of vitriol; they contained sulphur; and their percentage composition was about 86 carbon, 7 hydrogen, 7 oxygen, and a little sulphur—about 0.5 per cent. Whereas the tar produced at a low temperature was lighter than water—about .900 specific gravity; it would not oxidate or dry in the air; it contained hydrocarbons of the paraffin series, which are comparatively poor in carbon, and which can be burnt in a lamp; they are not much acted upon by strong oil of vitriol; they contain but little or no sulphur; and their percentage composition is about 84 carbon, hydrogen, and 4 oxygen. So also with the gases; at a temperature below 1800° they are rich in hydrocarbons of high illuminating power, and at a higher temperature they are comparatively poor in such hydrocarbons. The nature of the coal of course makes a large difference in the results, but the general expression of the fact is that high temperatures make a minimum quantity of tar, rich in carbon, and much gas with comparatively poor illuminating power, and with large proportions of sulphur compounds.

The raw gas as it leaves the retort, consists of aqueous vapour, vapour of tar, carbonic acid, carbonic oxide, ammonia, cyanogen, sulpho-cyanogen, sulphuretted hydrogen, bisulphide of carbon, sulpho-hydrocarbons, hydrogen, light carburetted hydrogen, olefiant gas, &c. Most of these are useless as illuminating agents, and therefore the necessity for purification. Fortunately, this, to a large extent, is easily effected by a natural process of condensation. As the gases and vapours cool, the condensable portions separate as liquid products, and thus in the hydraulic main and in the condensers the oily tar and the aqueous ammoniacal liquor separate of their own accord. The indications, therefore, of this first step of natural purification is to cool the raw gas as much as possible. But even when thus cooled it contains a large proportion of impurity which is soluble in water; and hence the next indication is the necessity for the use of a contrivance which shall bring the gas into contact with an aqueous solvent. Looking at the variable quality or composition of ammoniacal liquor, and that the proportion of ammonia in it ranges from about 1000 grains in the gallon to about 4000—or, in other words, that the saturating power of it per gallon is from about six ounces of the strongest sulphuric acid to twenty-six ounces—it is manifest that the best and proper washing liquid is ammoniacal liquor. This ought never to leave the gas-works with less than 2000 grains of ammonia in it per gallon, or with a less saturating power than thirteen ounces of sulphuric acid. There is no reason, indeed, why it should not always contain nearly double this quantity of ammonia. The use, therefore, of ammoniacal liquor as a washer of the raw gas is a natural inference. It was first suggested by Mr. Hawksley, and he has put it into practice with excellent effect, for not only does the ammoniacal liquor afford a means of removing ammonia, sulphuretted hydrogen, and carbonic acid from the raw gas, but being already saturated with hydrocarbons, it does not take up any more of these illuminating agents; besides which it can be used as a *douche* in such quantity in a large washer that it operates very successfully

as a cooling agent. The suggestions, indeed, of Mr. Laming, that every charge of ammoniacal liquor thus used might be first filtered through hydrated oxide of iron, so as to remove the sulphuretted hydrogen, and thus give it a more effective purifying power, is not without practical value. But even when the gas has been thus cooled, and has left the condensers, it is not so free from ammonia, carbonic acid, and sulphuretted hydrogen as that a small quantity of water properly distributed in a scrubber will not still further purify it; and the arrangement should be such that the water should trickle very slowly over a large surface, and reach the bottom of the scrubber almost saturated with the impurities. Leaving this part of the apparatus, the raw gas should never contain more than 1 volume in a 1000 of ammonia, 8 of sulphuretted hydrogen, and 20 of carbonic acid. These are in the proportion of 315 grains of ammonia, 5048 grains of sulphuretted hydrogen, and 16,336 grains of carbonic acid in 1000 cubic feet of gas. Then comes the chemical means whereby these can be best removed, and this involves an inquiry into the action of the purifiers, as they are called.

The order in which these impurities should be taken out is a matter of no slight importance. Chemistry teaches us that the first impurity to be removed is ammonia, for its presence checks the withdrawal of carbonic acid and sulphuretted hydrogen. Among the many suggestions which have been made for the absorption of ammonia there is none so effective as diluted sulphuric acid, and it is found that 49 parts by weight of the strongest sulphuric acid will remove 17 of ammonia. It will take, therefore, 909 grains, or rather more than 2 oz., of sulphuric acid to remove the ammonia from the 1000 cubic feet of gas. The acid is best used diluted with about its own bulk of water and sprinkled upon sawdust, which should be placed first in the trays of the purifiers; and the sawdust thus saturated with the ammonia is a valuable material, as it should contain fully half its weight of sulphate of ammonia. Other valuable absorbing agents have been proposed, as the spent acids of various manufacturing processes, the acid salt of alumina obtained by boiling clay shale with sulphuric acid (Croll), and the residual chloride of manganese from bleaching works. This has recently been used by Mr. Croll in the form of a nearly dry mixture with sawdust, and it yields a salt of ammonia remarkably free from impurities.

Next after the ammonia it is proper to remove the sulphuretted hydrogen, and unquestionably, if no sanitary considerations are concerned, the best agent for this purpose is wet lime—a material which will not only remove the sulphuretted hydrogen, but will likewise absorb the carbonic acid. Theoretically, 28 parts by weight of lime will take up 17 of sulphuretted hydrogen, and another 28 parts will take up 22 of carbonic acid. It follows, therefore, that about 3 lbs. of lime will absorb the carbonic acid, and $1\frac{1}{4}$ lb. the sulphuretted hydrogen in the 1000 cubic feet of gas—taking altogether about $4\frac{1}{2}$ lbs. of lime for 10,000 cubic feet of gas. But this is on the supposition that the lime is thoroughly effective, and that it is used in a very wet state; practically it is not so completely effective, and hence it takes about 50 lbs. of wet lime to purify 10,000 cubic feet of gas. If the lime is used in the dry state (as a hydrate) it is by no means so effective, for it requires fully twice the quantity of lime to purify the gas. This is due to the circumstance that the interior of the little lumps of lime is never reached by the gas, and therefore remains inoperative; besides which the lime is constantly getting drier in the purifiers by the heat of combination with the impurities of the gas, and as the lime dries it loses its capacity for absorbing these impurities; absolutely dry lime, in fact, will scarcely absorb sulphuretted hydrogen.

The offensive nature of spent lime, or blue billy, is such that a demand has been made on science to furnish a less objectionable means of purification; and hence the use

of the hydrated oxide of iron—a material which, when tolerably pure, will absorb sulphuretted hydrogen in the proportion of 17 parts of sulphuretted hydrogen to about 33 of the oxide. It will take, therefore, about 14 lbs. of the hydrated oxide to remove the sulphuretted hydrogen from 10,000 cubic feet of gas. It has then become a sulphide of iron, and has lost its power of purification, and must be revived. This is accomplished by simply exposing the oxide to the air, when it takes in atmospheric oxygen, and again passes into the state of hydrated oxide of iron, while the sulphur is set free in the mixture. The oxide thus charged is then used again and again, until it becomes charged to the extent of about 57 per cent. of sulphur, when it is no longer effective. Practically, a ton of oxide will, by successive revivification, purify about five millions of cubic feet of gas, and will absorb about 3600 lbs. of sulphuretted hydrogen. When thus charged with sulphur, it is valuable for manufacturing oil of vitriol.

If hydrated oxide of iron has been used as the purifier, lime must also be afterwards employed for the purpose of removing the carbonic acid, which is so destructive of the light of the gas when it is burned.

Having left the purifiers, the constituents of the gas are as follows:—

Hydrogen	.	.	.	.	25	to	50	per cent.	
Light carburetted hydrogen, C_2H_4	.	.	.	.	35	"	52	"	
Olefiant gas, C_4H_4	.	.	.	.	}	3	"	20	"
Propylene, C_6H_6					
Butylene, C_8H_8					
Other hydrocarbons, C_nH_n					
Benzole vapour, $C_{12}H_6$					
Acetylene, C_4H_2	.	.	.	.	.	5	"	9	"
Carbonic oxide CO	.	.	.	.	.	0	"	2	"
Carbonic acid, CO_2	.	.	.	.	.	?	"	?	"
Cyanogen, C_2N	.	.	.	.	.	0.01	"	0.06	"
Ammonia, NH_3	.	.	.	.	.	?	"	?	"
Bisulphide of carbon, CS_2	.	.	.	.	.	?	"	?	"
Sulpho-hydrocarbons	.	.	.	.	.	?	"	?	"
Aqueous vapour	.	.	.	.	.	2	"	3	"
Oxygen	.	.	.	.	.	0	"	1	"
Nitrogen	.	.	.	.	.	0	"	8	"

The properties of each of these constituents were demonstrated by experiment, and reference was made to their specific gravities, to their combining volumes, to the proportion of oxygen which they required for combustion, to the quantity of carbonic acid so produced, to the heat evolved, and to the action of water, chlorine, bromine, and anhydrous sulphuric acid upon them.

One of the interesting features of this part of the lecture was the production of acetylide of copper from the coal gas of the hall, and the exhibition of acetylene in large volume; as also the production of nitrobenzole from the gas, by passing it through fuming nitric acid.

As regards the means of determining the proportions of the condensable hydrocarbons in coal gas, Dr. Letheby showed that, as all the illuminating constituents of coal gas, excepting the light carburetted hydrogen, were absorbed by bromine and by anhydrous sulphuric acid, neither of these tests were worth anything as an indication of the illuminating power of the gas. In speaking of acetylene, he alluded to the fact that its production by the intense ignition of carbon in hydrogen was a remarkable example of the production of a hydrocarbon by the immediate combination of its elements; and he observed that as acetylene, which is such a powerful illuminating agent, may be made by the action of carbonic oxide on light carburetted hydrogen at high temperatures, it is possible that hereafter it will be found that by a proper arrangement of apparatus a high temperature may be best suited for the production of illuminating gas. The sole difficulty; perhaps, to be overcome will be the formation of carbonic oxide and marsh gas in proper proportions.

With respect to the existence of sulphur compounds in coal gas, Dr. Letheby demonstrated by many experiments

that sulphide of carbon and one or more sulpho-hydrocarbons were always present; and he showed the patented processes of Mr. Bowditch, Dr. Stenhouse, and Dr. Angus Smith, for removing these sulphur compounds. He referred also to his own apparatus for estimating the amount of sulphur in purified coal gas; and he likewise explained the means of determining the proportion of ammonia in gas, and he spoke of this impurity as a purveyor of the offensive tar-like hydrocarbons.

A slight reference was made to the subject of coal tar, and to the large field of chemical research which it had exposed to the chemist; and a few of the more interesting of the coal tar pigments were made, and nearly all the products were exhibited on the table.

PRINCIPAL CONSTITUENTS OF COAL TAR.

Acids.			
	Formulae.	Boiling-points.	Fahr.
Acetic . . .	$C_4H_4O_4$	248°	
Butylic . . .	$C_8H_8O_4$	315°	
Phenic . . .	$C_{12}H_6O_2$	370°	
Cresylic . . .	$C_{14}H_8O_2$	397°	
Phlorylic . . .	$C_{16}H_{10}O_2$	—	
Rosolic . . .	$C_{24}H_{12}O_6$	—	
Brunolic . . .	?	—	

Neutral.			
	Formulae.	Boiling-points.	Fahr.
Propylene . . .	C_6H_6	—	
Butylene . . .	C_8H_8	54°	
Amylene . . .	$C_{10}H_{10}$	102°	
Caproylene . . .	$C_{12}H_{12}$	131°	
Alliaceous . . .	?	?	
Benzole . . .	$C_{12}H_6$	176°	
Toluole . . .	$C_{14}H_8$	237°	
Xylole . . .	$C_{16}H_{10}$	259°	
Cumole . . .	$C_{18}H_{12}$	302°	
Cymole . . .	$C_{20}H_{14}$	347°	
Naphthaline . . .	$C_{20}H_8$	414°	
Anthracene . . .	$C_{28}H_{10}$	—	
Paraffine . . .	C_nH_n	—	
Pyrene . . .	$C_{30}H_4$	—	
Chrysene . . .	$C_{12}H_4$	—	

Alkalies.			
	Formulae.	Boiling-points.	Fahr.
Ammonia . . .	H_3N	—	
Methylamine . . .	C_2H_5N	—	
Ethylamine . . .	C_4H_7N	66°	
Petinine . . .	?	176°	
Cespitine . . .	$C_{10}H_{13}N$	205°	
Pyrrhidine . . .	$C_{10}H_5N$	271°	
Picoline . . .	$C_{12}H_7N$	273°	
Lutidine . . .	$C_{14}H_9N$	309°	
Collidine . . .	$C_{16}H_{11}N$	338°	
Aniline . . .	$C_{12}H_7N$	360°	
Parvoline . . .	$C_{18}H_{13}N$	370°	
Toluidine . . .	$C_{14}H_9N$	388°	
Coridine . . .	$C_{20}H_{15}N$	412°	
Xylidine . . .	$C_{16}H_{11}N$	415°	
Cumidine . . .	$C_{18}H_{13}N$	437°	
Rubidine . . .	$C_{22}H_{17}N$	446°	
Cryptidine . . .	$C_{22}H_{11}N$	—	
Leucoline . . .	$C_{18}H_7N$	455°	
Cymidine . . .	?	462°	
Viridine . . .	$C_{24}H_{19}N$	484°	

Lastly, in respect of the chemistry of the combustion of gas, Dr. Letheby showed under what circumstances it was best consumed, and he demonstrated in various ways, as by Erdmann's gas-prover, that the proper illuminating power of coal gas could only be obtained by an accurate adjustment of the air to the gas. This was chiefly accomplished in the Argand burner by a proper adaptation of

the internal aperture to the quality of the gas—a burner of only 0.42 of an inch internal bore was well suited for 11-candle gas, one of 0.44 of an inch for 13-candle gas, and one of 0.50 of an inch for 15-candle. In each of these cases the burner is used without a gauze diaphragm, and with a 7-inch chimney, the gas being burned at the rate of 5 feet an hour; but the same result and a steadier flame is obtained by using Sugg's burner of a little smaller diameter of the internal hole in each case, and a gauze diaphragm. By experiment with Leslie's burner, which is altogether unsuited for gas of low illuminating power, it was shown that the light of the gas might be seriously destroyed.

The relative values of different illuminating agents were shown by the following table:—

Relative Values of Illuminating Agents in respect of their Heating and Vitiating Effects on the Atmosphere, when burning so as to give the Light of Twelve Standard Sperm Candles.

	Pounds of Water heated to 1° Fahr.	Oxygen consumed (cub. ft.).	Carbonic acid produced (cub. ft.).	Air vitiating (cub. ft.).
Cannel gas . . .	1950	3.30	2.01	50.2
Common ditto . . .	2786	5.45	3.21	80.2
Sperm oil . . .	2335	4.75	3.33	83.3
Benzole . . .	2326	4.46	3.54	88.5
Paraffin . . .	3619	6.81	4.50	112.5
Camphine . . .	3251	6.65	4.77	119.2
Wax candles . . .	3831	8.41	5.90	149.5
Sperm ditto . . .	3517	7.57	5.27	131.7
Stearic ditto . . .	3747	8.82	6.25	156.2
Tallow ditto . . .	5054	12.06	8.73	218.3

In conclusion, the lecturer observed that every day brought to light some new fact connected with the chemistry of gas manufacture, which deserved the careful consideration of all who, like those to whom he was addressing himself, were practically engaged in this important branch of industry. He had endeavoured to lay before them, with as much fulness as time allowed, the most prominent features of the question, as far as the light of science had at present elucidated them; but the subject, in all its details, was far too complex to allow of more than a mere general statement in the compass of a single lecture.

ACADEMY OF SCIENCES.

October 17.

Our usual report of the French Academy was by accident omitted last week. At the last sitting but one, M. Kuhlmann continued his memoir "*On the Crystallogenic Force.*" In this part he refers to some simple matters well known to most of our readers; we mean the crystallisation on glass of saline solutions, thickened with gum. Sulphate of magnesia is generally used by barbers and others who ornament their windows in this way, but M. Kuhlmann states that the prettiest effects are obtained with a solution of sulphate of zinc, and he points out how the appearance may be improved by painting over the crystallisation with an alcoholic solution of some colouring matter such as fuchsine. Beautiful as some of these crystallisations are, we all know that they are very unstable, and M. Kuhlmann tried various varnishes with the hope of perpetuating the appearances. None of them however, answered, and at last he thought of copying them by photography. With Mr. Bingham's assistance he obtained some beautiful pictures on collodion plates, and also copied the crystallisations directly upon paper. Very pretty pictures, too, it seems can be obtained for the stereoscope. M. Kuhlmann also tried the galvano-plastic method of reproducing his crystalline pictures, so as to be able to print them upon paper or fabrics. For this purpose he obtained the crystallisation upon a thin plate of copper, and copied it by passing this plate on another through a powerful rolling machine. The forms were beautifully preserved,

notwithstanding the great pressure, and the plates could be used for printing as soon as they came from the rollers. M. Kuhlmann suggests that the designs may also be copied by pressing gutta percha on glass plates covered with the crystals. The gutta-percha moulds may then be copied by the electrotpe process. It was suggested that this style of ornamentation might be substituted for ordinary chasing on articles of gold and silver, and a specimen so ornamented was exhibited to the Academy. M. Kuhlmann gave some idea how a continuous picture might be obtained by procuring the crystallisations on one cylinder of copper and transferring them to another cylinder, but technical details on this point are still wanting. The author lastly pointed out that no two crystallisations are obtained exactly alike. They can only be copied by photography, for the fineness of the designs would defy the burin of the most clever engraver; he therefore suggests that the designs would be useful for bank notes. Copper plates might be obtained in the way described, and if the design were printed in pale blue ink on a bright yellow ground, the photographer and the engraver would both be defeated in obtaining a counterfeit.

M. Scheurer-Kestner presented an additional note "*On Leblanc's Process.*" The author has now settled the reactions which take place in the formation of black ash, and he thus expresses them:—The reactions pass through three phases: in the first, sulphate of sodium is reduced to sulphide, carbonic acid being given off—



then a double decomposition takes place between the sulphide of sodium and carbonate of calcium—



lastly, a partial reduction of the carbonate of calcium employed in excess is effected by the carbon, carbonic oxide being disengaged— $2\text{CaCO}_3 + 2\text{C} = 2\text{CaO} + 4\text{CO}$. This reduction is arrested by the cooling of the mass.

The theoretical quantity of carbon required for these reactions rises from 16.8 to 20.2 for 100 parts of sulphate of sodium.

The addition of an excess of chalk, then, is doubly useful. It seems to replace that portion which is reduced to oxide in the course of the operation, and it allows us to see the exact moment at which the reaction is terminated, for the mixture must be drawn from the furnace after the disengagement of carbonic oxide has begun, and before the evolution of the gas has ceased.

October 24.

At this sitting, M. S. Meunier presented a note entitled "*Contributions to the History of Sulphur and Iodine.*" The object of the author was to explain two singular facts observed by Diezenbacher, namely, that a small proportion of iodine fused with sulphur at 180° gave lasting plasticity to the sulphur, and also that the action of iodine rendered the sulphur completely insoluble in bisulphide of carbon. Iodine fuses at 117°, and sulphur about 110°; but a mixture of one part of iodine and ten parts of sulphur becomes liquid between 92° and 95°. A mixture of seventy parts of iodine and one of sulphur becomes pasty about 95°. The reason of this, according to the author, is that at a moderate temperature the mixture is converted into a compound of iodine and sulphide of iodine. The sulphide of iodine, IS_2 , fuses at 90°, and, if slowly cooled, remains soft for a time, and a small proportion of the compound, fused with a large excess of sulphur had the effect of rendering the latter soft and insoluble. M. Meunier found that bisulphide of carbon completely separated the two elements. The author accounts for the fact that one part of iodine will render 400 parts of sulphur insoluble by supposing that at a high temperature the iodine combines successively with every molecule of the sulphur, the compound being destroyed by the increasing heat, and in the end the whole of the iodine vaporised, the vapour, as it reversed the mass, having changed the molecular state of

the sulphur. The author quotes a singular fact observed by Peligot, who found that the totally insoluble sesquichloride of chromium was instantly rendered soluble by the addition of $\frac{1}{10000}$ th of the soluble protochloride.

M. Hautefeuille made a communication "*On the Artificial Production of Sphene and Perowskite,*" two titanium minerals of no great interest.

MM. Bussy and Buignet gave an account of the results of a long series of experiments "*On the Changes of Temperature produced in Mixtures of different Liquids.*" The authors experimented principally with volatile liquids, such as ether, alcohol, chloroform, and bisulphide of carbon. Their paper was long and interesting, but we have only space for the conclusions to which their experiments led them:—

1. When two liquids which dissolve in each other in all proportions are mixed, some change of temperature always occurs; sometimes it rises, and sometimes it falls.

2. This effect is the consequence of two causes—either *affinity* between heterogeneous molecules which produce heat, or *diffusion*, which consists in the movement of homogeneous molecules, in order to be distributed through the mass, and which produces cold.

3. When the two liquids mixed have but a weak affinity for each other the effects of diffusion become sensible, and produce a fall of temperature.

4. The rise or fall of temperature does not entirely depend on the nature of the liquids; it varies for the same mixture according to the relative proportions of the liquids.

5. The influence of the relative proportions may completely alter the thermometric effect; 5 of alcohol with 1 of chloroform cause the thermometer to rise 4°.5; on the contrary, 5 of chloroform with 1 of alcohol cause a fall of 2°.6.

6. The initial temperature of the liquids when mixed have a sensible effect on the result in general; the fall is more marked when the initial temperature is high.

7. Liquids undergo a change of volume as well as of temperature when mixed. Sometimes there is dilatation, as with alcohol and sulphide of carbon; sometimes there is contraction, as with alcohol and ether.

8. There is no apparent relation between the changes of temperature and volume; some mixtures which contract produce heat, while others which also contract produce cold.

A short discussion followed, in the course of which M. Pasteur characteristically introduced the subject of fermentations, decompositions, in the course of which heat is evolved. These phenomena, he said, may be regarded as slow explosions.

NOTICES OF BOOKS.

Annales de Chimie et de Physique. September, 186.

IN this journal we have a long paper by M. Marignac "*On the Silico-tungstic Acids,*" with a note on the constitution of "*Tungstic Acid.*" We gave some account of these acids when the author first communicated his researches to the Academy of Sciences. [See CHEMICAL NEWS, vol. ix., pp. 230, 279.] The present communication is mainly occupied with a description of the alkaline salts of the acids mentioned in the former paper. In the note on the constitution of tungstic acid the author gives his reasons for adopting the view of Persoz, who regards the formula WO_3 as most probably correct for tungstic acid.

M. Marignac's paper is followed by the second part of an important communication "*On the Mechanical Theory of Heat,*" by M. Dupré. It is a profound mathematical paper, and we can only transcribe the title.

The only other article is a translation of Mr. Graham's paper "*On the Properties of Silicic and other Colloid Acids,*" which has appeared in the CHEMICAL NEWS.

Bulletin de la Société Chimique de Paris, &c. October, 1864.

THE papers read before the Chemical Society of Paris have for the most part been previously communicated to the Academy of Sciences, and are consequently noticed in our reports of the proceedings of that learned body. Such has been the case with the leading papers in this number of the *Bulletin*.

From the analyses of articles on pure and applied chemistry published with the proceedings of the Paris Society we often borrow; but in the present instance all the papers of interest have already appeared in our pages.

Chemisches Central-blatt. October 26, 1864.

FOR the future we shall add the contents of this useful periodical to our notices of foreign journals. The remark we have made above on the contents of the Journal of the Chemical Society of Paris will apply to this number of the *Central-blatt*, which offers little of interest which has not appeared in the CHEMICAL NEWS.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2460. Benedict Margulies, Trieste, Austria, now residing at St. Helens, Lancashire, and John Knowles Leather, of the same place, "Improvements in the manufacture of salts of chromium."

2465. Peter Armand Le Comte de Fontainemoreau, Rue de la Fidélité, Paris, France, and South Street, Finsbury, London, "Certain improvements in photography for obtaining images direct on cloth and other materials."—A communication from Jean Nicholas Truchelut, Rue de Grenelle, St. Honore, Paris, France.—Petition recorded October 6, 1864.

2468. Thomas Parkins, Robert Town, near Normanton, Yorkshire, "Improvements in apparatus used in the manufacture of prussiates of potash."

2472. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "An improved process for purifying coal and ores."—A communication from Benjamin Franklin Penniman, city, county, and state of New York, U.S.A.

2475. Thomas Kenyon, the younger, Miles Platting, Manchester, Lancashire, "Improvements in preparing, fixing, and mordanting cloth and yarns."—Petitions recorded October 7, 1864.

2487. John Cassell, La Belle Sauvage Yard, London, "Improvements in treating coal, peat, shale, wood, and ligneous products, and in obtaining fuel, oil, and other products therefrom."—Petition recorded October 10, 1864.

2504. Hiram Tucker, Newton, Middlesex, Massachusetts, U.S.A., "An improved process for bronze-colouring iron."

2506. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of ink."—A communication from Josiah Vincent Lavers, Sydney, New South Wales.

2510. Frederick Wilkins, of Oxford Street and Regent Street, Middlesex, "Improvements in apparatus for the production of hydrocarbon vapour, and for the application of the same to illuminating or heating purposes."—Petitions recorded October 11, 1864.

2525. John Watson, Lombard House, George Yard, London, F.G.S., "Improvements in the manufacture of hydrocarbons."—Petition recorded October 13, 1864.

2533. William Robert Sykes, Pimlico, Middlesex, "Improvements in apparatus for transmitting positive and negative currents of electricity."

2535. Joseph Watts, Coventry, Warwickshire, "Im-

provements in apparatus for conducting the fermentation of wort and other fermentable liquids."—Petitions recorded October 14, 1864.

2559. Alfred Hill, Birmingham, Warwickshire, "Improvements in privies, dry closets, and commodes, and in deodorising substances to be used in privies, dry closets, and commodes."—Petition recorded October 17, 1864.

2573. Nathan Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in stoppers for bottles, jars, and other vessels, and in stoppers for the muzzles of firearms."—Petition recorded October 18, 1864.

Notices to Proceed.

1452. Peter Spence, Newton Heath, Lancashire, and John Berger Spence, of the same place, "Improvements in calcining and smelting copper ores."—Petition recorded June 11, 1864.

1498. George Hyacinthe Ozoup, Rue Sainte Appoline, Paris, France, "Improvements in the manufacture and utilisation of carbonic acid, and in apparatus connected therewith."—Petition recorded June 16, 1864.

1513. William Henry Tooth, of Rhodeswell Road, Stepney, Middlesex, "Improvements in furnaces or apparatus for generating carburetted hydrogen, carbonic acid, carbonic oxide, and cyanogen gases."

1514. William Henry Tooth, Rhodeswell Road, Stepney, Middlesex, "Improvements in the manufacture and refining of iron, and in the manufacture of steel."—Petitions recorded June 17, 1864.

1523. Richard Jones, Botolph Lane, Eastcheap, "An improved method of preserving animal and vegetable substances."—Petition recorded June 20, 1864.

1538. William John Pughsley, Christchurch, Monmouthshire, "Improvements in obtaining sulphuric acid from the refuse 'pickle' used in tin-plate works, and also from sulphate of iron or green copperas."—Petition recorded June 21, 1864.

1561. John Jones, New North Road, Middlesex, "Improvements in dry gas-meters, parts of which are applicable to apparatus for regulating the flow of air."—Petition recorded June 22, 1864.

2018. Edward Andries, Schaerbeek, near Brussels, Belgium, "Improvements in means or apparatus for purifying every kind of water, and rendering it drinkable, and for rendering sea water fresh and drinkable."—Petition recorded August 23, 1864.

2175. John Knowles Leather, St. Helens, Lancashire, "Improvements in the manufacture of salts of chromium from chrome ore."—A communication from Benedict Margulies, Trieste, Austria.—Petition recorded September 6, 1864.

2443. John Johnson and Thomas Johnson, Runcorn, Cheshire, "Improvements in purifying resin and resinous substances."—Petition recorded October 4, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, October 28.

THERE is rather a dearth of scientific news just now in Paris. We are waiting for the "season," which will soon set in, and no doubt furnish plenty of materials for gossiping letters. In the meantime I may call attention to one or two industrial novelties—one of which may, perhaps, turn out to be of some value. The first is a process for making a neutral acetate of copper. M. Jonas, the author of the process, takes common blue vitriol, dissolves it in caustic ammonia, then adds to the deep blue solution twice the weight (of the sulphate) of acetate of soda, and boils the whole. Silky crystals of acetate of copper immediately appear on the surface and fall to the bottom on agitating the liquid, allowing the formation of a new quantity. The crystals are easily collected and dried on calico or a paper

filter: they are said to have a brighter colour than those obtained by the old process, and also to be more soluble in water.

The other process alluded to is the method just patented for obtaining a hardened surface on cast iron. The object or instrument to be hardened is made red hot, and then dipped and allowed to cool in a mixture of 1080 grammes of sulphuric acid, 65 grammes of nitric acid, and 10 litres of water. The thickness of surface hardened is said to be sufficient for ordinary use, and the shape of the object is not at all changed by the operation.

Some talk has been recently excited by the starting of a steam omnibus at Nantes. The papers mention with apparent surprise that there were plenty of passengers who had the courage to ride in it, and only suffered some jolting caused by the badness of the road or the want of springs.

At St. Ouen they have lately launched some iron vessels intended to serve as stores for inflammable liquids. They seem to have a special dock for these vessels, and it is supposed that all danger from fire will be obviated by keeping the dangerous fluids on the water. Would not something of the same kind answer for petroleum stores in the Thames and Mersey?

A few days ago three men were suffocated in a sewer at Clichy, and the journals now call attention to a simple form of apparatus which should always be furnished to workmen who are exposed to dangers of the kind. It consists of two india-rubber tubes furnished, we suppose, with valves, through one of which the man inspires, the other carrying off the expired air. The workman has only to fix the open end of these tubes to the top of the ladder, and then descends with a wooden mouth-piece between his teeth. He is thus ensured free communication with the external air, and may remain in the sewer without danger. By the aid of the same apparatus it is said that a man may take his bath entirely submerged, and so derive a great deal more benefit from the operation.

It may interest some of your readers who dread sea sickness, and wish to make a voyage to this country, to be informed that some apparatus designed to save people from the unpleasant malady has been set up in one of the boats plying between Southampton and Havre. I am sorry that I am unable to say which boat, and tell you how the apparatus answers.

M. A. Houdin, of Passy, appears to be teaching the deaf and dumb to speak with great success. A Commission from the Academy lately visited his establishment, and reported that the pupils perfectly understood the questions by observing the motions of their lips, and made oral replies which showed an advanced degree of intelligence. Surely it is worth while for some Englishman to study the methods of M. Houdin.

Italy is truly making progress. They vaccinate in Naples, but not in the common-place way they do here and in London. There is an establishment in which a stock of heifers with the cow-pox is kept, and when a child is to be vaccinated the order is given, a heifer is driven up to your door, the driver nips off an entire pustule, and the doctor then performs his part of the operation. These heifers may be seen going about the streets of Naples, just as I have seen, in years gone by, cows going about the streets of London to be milked at the doors of people who were afraid of a little pump-water. The matter costs a dollar, and at that rate I should think that vacciferous heifers must pay better than milch cows. It is only fair to King Ferdinand to say that this institution had his support and patronage.

Perhaps you will one day have added to your London cries,—Fresh *lymph* from the cow-ow!

Speaking of Naples, we may add that a scientific congress is about to assemble in that city, to which the Committee invite all *savants*.

I should be sorry to assist quackery or spread a delusion,

but I feel bound to inform you that a diet of maize flour is said here to be a certain cure for consumption. It is eaten in the same way as arrowroot, and milk is recommended to be used with it.

Volumetric Determination of Iron.

To the Editor of the CHEMICAL NEWS.

SIR,—Having occasion to make some determinations of iron in solutions of sesquioxide of iron, and finding considerable difficulty in reducing the solution completely with zinc, I tried sulphuretted hydrogen, and found it to answer much better than either zinc or sulphurous acid. A solution of sulphide of sodium was employed by me in the experiments. The reduction, even in a strongly acid solution, takes place immediately; and on boiling until the sulphuretted hydrogen is expelled, the sulphur separated coagulates completely; so that, after allowing the solution to cool in the flask in which it has been boiled, a cork being placed in the neck during the cooling, filtration may be effected so rapidly that no oxidation need be feared, and the determination may then be effected with permanganate as usual. It is better to add a considerable quantity of water to the solution before reduction to avoid the oxidation which would afterwards ensue in the filtration of a concentrated solution of protoxide of iron.

I am, &c. ARTHUR REYNOLDS, B.Sc.

The Sulphuring of Hops.

To the Editor of the CHEMICAL NEWS.

SIR,—Will any of your scientific readers suggest to me a ready practical method for detecting whether sulphur has been used in the curing of hops or during their growth? Sulphur is used extensively by the hop-growers, and is very prejudicial to the brewers' fermentations.

I am, &c. A BREWER.

MISCELLANEOUS.

Royal Institution.—The general monthly meeting will be held on Monday, November 7, at 2 o'clock.

Use of Pharmacutists.—An ill-informed pharmacist is more dangerous than an ignorant physician; for the former may cause the death of the patient directly, while the physician has a *lightning conductor* in the way of his homicidal prescriptions; and this lightning conductor is the pharmacist.—*Le Moniteur Scientifique*, vol. vi., p. 920.

Benzine as an Insecticide.—A mixture of ten parts benzine, five parts soap, and eighty-five water, has been very successfully used by Gille to destroy the parasites which infests dogs. It has also been used with good results in veterinary practice, as an application in certain diseases of the skin; and thus diluted, is found to answer better than when pure.—*Bull. de Ph. de Brux. N. Jahrb. Ph.* xxi. 36.

ANSWERS TO CORRESPONDENTS.

Chemicus (Blackfriars).—We know of none but careful rectification.

A. Merry.—We will apply to our correspondent for the information, and write if he can furnish it.

A Young Amateur Chemist.—There is a hyposulphite of magnesia, but we do not expect you have it in the mixture described.

W. C. C.—Borax gives with salts of the protoxide of manganese a white precipitate, which is the compound in question.

Z.—A mixture of equal parts of sal ammoniac and slaked lime is put in a capacious retort, which is connected with a series of Wölfe's bottles about half full of water. The first bottle at the end of the operation will contain a solution of about the density.

Chemicus.—The strength may be determined by any alkali. A volumetric method would be most easy. We do not know what is meant by "degrees" as applied to this article.

Received.—Mr. Galletly; Mr. Catton, with thanks.

SCIENTIFIC AND ANALYTICAL
CHEMISTRY.

On the Relations of Hyposulphite of Soda to Certain Metallic Oxides, by WALCOTT GIBBS, M.D., Rumford Professor in Harvard University.

No. I.

THE employment of hyposulphite of soda as an analytical reagent was first suggested by Himly,* who, in a short paper, intended only as a preliminary notice, pointed out the relations of this salt to solutions of arsenic, antimony, copper, and platinum, and suggested its use as a general reagent in place of sulphydric acid. Himly's paper attracted little attention, and was soon forgotten. The subject was again taken up at about the same time by Vohl† and Slater,‡ who appear to have been unacquainted with Himly's results. Vohl's investigation embraces the action of the hyposulphite upon solutions of arsenic, antimony, tin, copper, mercury, silver, gold, platinum, lead, bismuth, and cadmium. Slater studied the action of the salt upon solutions of chromium in the form of chromic acid, arsenic, antimony, copper, bismuth, lead, and mercury, as well as upon ferridcyanide, ferrocyanide, and cyanide of potassium, and upon sulphocyanide of iron and hypermanganate of potash. The results obtained by these chemists differ in some particulars, especially as regards copper and lead. More recently Chancel§ has employed the hyposulphite for the separation of alumina from iron, and Stromeyer|| has extended the same process to the separation of iron from titanate acid and zirconia. Other analytical applications of the hyposulphite have been made in which the salt is employed either as a solvent or in volumetric processes; these do not require notice in this place. The following observations on the behaviour of the hyposulphite towards certain metallic salts are interesting from a purely chemical rather than from an analytical point of view.

Nickel.—When a neutral solution of sulphate, chloride, or nitrate of nickel is boiled with a solution of hyposulphite of soda, a black precipitate of sulphide of nickel is thrown down, and after a very long boiling the precipitation is complete, and the solution is free from nickel. If the solution of nickel be previously acidulated by the addition of a drop or two of acetic acid, the precipitation is more rapid. It is very difficult to determine the exact point at which the solution ceases to contain nickel; the boiling must usually be continued for several hours. When chlorhydric acid is added to the mixed solutions of nickel salts and hyposulphite, no precipitate is produced on boiling; in this case nickel behaves like iron and the other metals of the same group; in the cases first mentioned its analogies are with copper. The presence of free ammonia does not prevent the precipitation of sulphide of nickel, but the action goes on very slowly. Rammelsburg¶ long since observed that a solution of hyposulphite of nickel is partially decomposed by evaporation, and that the dry mass on heating yields a yellow sulphide of nickel; the same is true of a mixed solution containing sulphate of nickel and hyposulphite of soda.

The formation of sulphide of nickel, which takes

place slowly in solutions evaporating or boiling under ordinary atmospheric pressure, is facilitated in an extraordinary degree by heating in closed tubes to a temperature of 120° C. Ordinary combustion tubes answer the purpose very well; the tube is first closed at one end, and then drawn out near the other end to a narrow neck. The solution of nickel is introduced by a long funnel, together with the solution of hyposulphite, which should be in excess, and concentrated. After sealing the tube before the blast-lamp, it is to be heated in an air-bath, and kept for half-an-hour at a temperature of about 120° C. Every trace of nickel is thrown down in the form of sulphide mixed with free sulphur; the tube may then be opened at the point, the liquid allowed to flow into a beaker, the tube cut across, and the sulphide of nickel washed out. It may be thrown on a filter and washed with boiling water without oxidising in the smallest degree. The equation representing this reaction appears to be—



This process answers extremely well for the analysis of nickel salts, and gives more accurate results than the precipitation of the nickel as oxide by caustic potash; it also requires less time, since the sulphide may be washed with the greatest ease. On the other hand, as I shall show, it is of very limited application as a means of separating nickel from other metals. The sulphide of nickel precipitated by heating with solution of hyposulphite of soda appears black at first, but after ignition has a dark bronze-yellow colour. It is unchangeable in the air, and may be boiled with strong chlorhydric acid without being sensibly attacked. Strong sulphuric acid exerts no action upon it. Nitric acid oxidises it to sulphate of nickel. It may be heated in a covered porcelain crucible without oxidation, but by roasting in a current of air is converted into basic sulphate. For quantitative purposes it is best after washing and drying the sulphide to burn it with the filter in a porcelain crucible, so as to convert it into basic sulphate; to add to this a few drops of sulphuric acid, evaporate to dryness, and gently ignite the resulting neutral sulphate, from the weight of which the nickel may be calculated. The sulphate must be completely soluble in hot water. Rose has shown that the sulphate may be completely converted into oxide by strong ignition.**

Cobalt.—The relations of cobalt to hyposulphite of soda are almost identical with those of nickel; the only marked difference consists in the much greater difficulty with which cobalt is precipitated. In fact, a complete precipitation under the ordinary atmospheric pressure is almost impossible. In a sealed tube, at a temperature of 120° C., the precipitation is complete in an hour at farthest. The sulphide is black, and is almost, if not quite insoluble in acids, as the sulphide of nickel; it may be washed upon a filter with boiling water, and does not oxidise in the air. When heated to redness in contact with air, it is readily oxidised to sulphate of cobalt, which is not basic unless the temperature is very high. In all cases, however, it is best to treat the roasted sulphide with a few drops of sulphuric acid, evaporate, and ignite gently. The cobalt may then be calculated from the weight of the sulphate. Cobalt may be easily determined quantitatively in soluble neutral salts by this process; as in the case of nickel, however, the hyposulphite of soda serves to separate cobalt from other metals only in a very limited number of cases. Nickel

* *Annalen der Chemie und Pharmacie*, xliii., 150.

† *Ibid.*, xcvi., 237.

‡ *Chemical Gazette*, 1855, 369.

§ *Comptes Rendus*, xlv., 987.

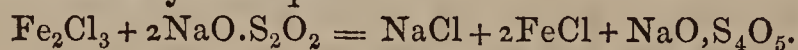
|| *Ann. der Chem. und Pharm.*, cxiii., 127.

¶ *Pogg. Ann.*, lvi., 295.

** *Pogg. Ann.*, cx., 132.

and cobalt are completely precipitated together as sulphides by hyposulphite of soda at 120° C.; it is best to weigh them together as sulphates, and then determine the cobalt by Stromeyer's method as modified by Dr. Genth†† and myself; the nickel is then found by simply subtracting the weight of sulphate of cobalt from that of the mixed sulphates.

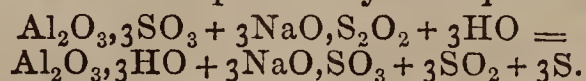
Iron.—A solution of peroxide of iron becomes of a deep violet colour upon the addition of hyposulphite of soda; after a short time the colour disappears, and the iron is reduced to protoxide. According to Fordos†† and Gélis the reaction which takes place in this case is represented by the equation—



A solution of a protosalt of iron may be boiled or evaporated with hyposulphite of soda without undergoing any perceptible change. When, however, the two solutions are heated together for an hour or more to a temperature of 130° to 140° C., the hyposulphite of soda being in excess, the whole of the iron is thrown down as a black sulphide, which is not oxidised by exposure to the air, and is not sensibly dissolved by strong chlorhydric acid. Nitric acid readily oxidises it; dilute sulphuric acid has no sensible action. The complete precipitation of iron as sulphide under these circumstances requires a longer time and a higher temperature than that of either cobalt or nickel; the sulphide is the protosulphide FeS , and is readily oxidised to sesquioxide by ignition in a current of air.

When sesquioxide of iron, which has been strongly ignited so as to be with difficulty soluble in acids, is mixed with an excess of dry hyposulphite of soda and heated to redness, a black sulphide is formed, which is readily soluble in chlorhydric acid with evolution of sulphydric acid gas. Nickel and cobalt give insoluble sulphides under the same circumstances; nevertheless, I have not found it possible to separate iron quantitatively from either of the other two metals by this process. From what has already been stated it will also be evident that heating with solutions of the hyposulphite also fails to separate iron from cobalt and nickel.

Alumina.—A dilute solution of alumina, according to Chancel, is completely precipitated by long boiling with hyposulphite of soda, as a hydrate which is easily washed. The reaction is here expressed by the equation—



The boiling must be continued until the whole of the sulphurous acid is expelled. Chancel applies this reaction to the quantitative separation of alumina from iron, but I have always found that the complete precipitation of the alumina is, to say the least, extremely difficult. This may be due to the formation of a sulphite which is not decomposed by boiling. When a solution of alum is heated to 120° C., with a strong solution of hyposulphite of soda, the whole of the alumina is precipitated after a short time, as a hydrate mixed with sulphur. The precipitate is white, and of a peculiar semi-gelatinous character; it is more easily washed than ordinary hydrate thrown down by ammonia. It is almost completely insoluble in cold and strong chlorhydric acid, but is slowly dissolved by boiling. Dilute sulphuric acid has no action upon it; strong sulphuric acid and nitro-muriatic acid dissolve it with difficulty.

Zinc.—When solutions of sulphate of zinc and hypo-

sulphite of soda are heated together in a closed tube to 120° to 140° C., the zinc is partially precipitated as a yellowish white powder, which is a mixture of sulphide of zinc and free sulphur. A large quantity of zinc remains in solution.

Manganese.—Sulphate of manganese and hyposulphite of soda may be heated together to 120° C., without any apparent action. When, however, iron is present, the precipitated sulphide of iron always contains manganese, which cannot be separated from it by acids.

The insolubility of the sulphides of cobalt and nickel, when precipitated in the manner above described at high temperatures, led me to examine the behaviour of the sulphides when precipitated under ordinary atmospheric pressure from boiling solutions. When a boiling solution of sulphide of sodium is added to a boiling solution of sulphate of nickel or cobalt, the sulphides are completely precipitated in such a state of aggregation that they may be thrown upon a filter, washed with boiling water, and dried in the air without the least oxidation. It is well before filtering to render the liquid slightly acid, so as to avoid free sulphide of sodium; acetic acid answers best for this purpose. The sulphide of nickel or cobalt, or the mixed sulphides, may be converted into sulphates, and weighed as such.—*American Journal of Science*, vol. xxxvii., p. 346.

Analysis of Parisite; Separation of Cerium, Lanthanum, and Didymium, by MM. DAMOUR and H. DEVILLE.

M. BOUSINGAULT has recently received several specimens of *Parisite* from New Grenada, which he confided to the authors for analysis. The following was the process they adopted:—

The mineral reduced to fine powder was treated with cold weak acetic acid, to separate a small quantity of carbonate of lime, accidentally mixed with it, the presence of which is easily accounted for, parisite, like emerald, being found in a vein of carbonate of lime.

Thus purified it was digested, still cold, in nitric acid; carbonates of cerium, lanthanum, and didymium slowly dissolved, with disengagement of carbonic acid; a scaly powder remained, composed of fluorides of calcium and cerium, which was collected on a filter and weighed, after having been heated to redness. These fluorides were decomposed by sulphuric acid. A mixture of sulphates of lime and cerium was thus obtained and dissolved in hydrochloric acid. Ammonia poured into the acid liquid precipitated cerous oxide, which, after calcination, was estimated in the state of ceroso-ceric oxide. The lime transformed into oxalate and decomposed by calcination, was weighed in the state of caustic lime. Subtracting the united weights of cerous oxide and lime from the weight of fluorides, we have, by difference, the weight of fluorine.

The nitric liquid separated from the fluorides was supersaturated by caustic potash which precipitated all the oxides in the state of gelatinous hydrates. These oxides were washed several times by decantation, and then a concentrated solution of caustic potash was added, and the whole submitted to a current of chlorine. The alkaline liquid being thus saturated with chlorine, the oxides of lanthanum and didymium were re-dissolved, lemon-coloured insoluble ceric oxide remaining. This substance was collected on a filter, then re-dissolved, while still moist, in hydrochloric acid, and precipitated by oxalate of ammonia, strongly calcined; the cerous oxalate was transformed into very light rose-coloured ceroso-ceric oxide, Ce_3O_4 .

†† *Amer. Journ. of Science* [2], xxiv., p. 86.

†† *Ann. de Chimie et de Physique*, viii., 351.

The chlorinated liquid containing oxides of lanthanum, didymium, and a little lime, was treated by oxalate of ammonia, which precipitated the three bases as oxalates. They were weighed after being washed and calcined, then digested with very weak nitric acid by M. Mosander's method. A little oxide of cerium remained undissolved, and was added to that already obtained in the preceding operation.

The nitric acid solution of oxides of lanthanum and didymium, coloured violet red, was saturated with ammonia; the lime remained in the liquid while the other oxides were precipitated in a gelatinous state. The lime was estimated as caustic lime, after precipitation by oxalate of ammonia, and calcination of the oxalate; a little lanthanum and didymium were found mixed with it and were taken into account in the final result.

The oxides of didymium and lanthanum were re-dissolved in nitric acid, and the nitrates evaporated to dryness in a flat-bottomed capsule. The dried mass was of a pale rose tint. By exposing the capsule for a few minutes to a temperature of 400° or 500° the saline mass was fused with disengagement of nitrous vapours. The capsule was withdrawn from the fire before the decomposition was complete, and hot water was poured in. Part of the matter dissolved and part remained insoluble in the form of greyish-white flakes (with no nitrate of didymium). The whole was left to stand for a few hours, then boiled and filtered; and as the liquid still retained a feeble rose tint, the same operation was repeated three times before a colourless liquid was obtained, containing nitrate of lanthanum, separated from subnitrate of didymium. Oxide of lanthanum was determined by evaporating this liquid and strongly calcining the residue. The oxide of didymium was also estimated after the calcination of the subnitrate thus obtained.

This process is founded on the fact that nitrate of didymium decomposes before nitrate of lanthanum, and that the first of these salts changes to the state of subnitrate, $4\text{DiONO}_5 + 5\text{HO}$ (this salt has already been observed and described by M. Marignac). Several precautions must be observed. The bottom of the capsule containing the mixture of the two salts must not be too much heated, nor must too large quantities of material be used, as in that case it forms a thick layer at the bottom of the capsule and decomposes unequally. It is better to recommence the operation several times than to heat too strongly in attempting to separate the two oxides at the same time. The first portions of oxide of didymium obtained in this way give, with sulphuric acid, reddish-violet crystals, with traces of white needle-form ones, which seem to belong to the sulphate of lanthanum. The last portions give a sulphate less coloured, but like the preceding with the same crystalline form derived from the oblique rhomboidal prisms; the needles of sulphate of lanthanum are rather more numerous; in short, the above-described colourless solution gives, with sulphuric acid, colourless crystals derived from the right rhomboidal prism characteristic of sulphate of lanthanum.

By following this method we obtain rather too high an estimation of oxide of didymium, and consequently one rather too low of oxide of lanthanum. By operating on a mixture of these oxides previously weighed, we found that the excess of oxide of didymium varied from 5 to 6 per cent.

We cannot, then, give this mean analysis as yielding precise results, but it may prove a sufficiently near approximation.

Oxide of lanthanum calcined at white heat, and put in contact with a concentrated solution of ammoniacal

nitrate readily dissolves, even without heat, disengaging ammoniacal gas; oxide of didymium similarly treated also dissolves, but somewhat more slowly; consequently this property cannot be utilised for the separation of the two oxides. To estimate the carbonic acid combined with oxides contained in parisite, a gramme of this mineral, reduced to a very fine powder, was heated to whiteness in a current of nitrogen; the decrease in its weight gave the quantity of carbonic acid disengaged; the number obtained very nearly corresponds to that already determined by M. Bunsen. The fluorides contained in the parisite are not decomposed by this calcination.

Having endeavoured to collect the proportion of water existing, according to M. Bunsen's analysis in parisite, we placed a gramme of this substance, reduced to an impalpable powder in a platinum boat, which we placed in a crucible of the same metal six centimetres long, with a screwed cover furnished with a small tube, traversing a stopper of hard asbestos in a glass tube, bent to a semicircle and tapered at the extremity opposite to that where the small platinum tube is placed. The glass tube intended to collect the water disengaged during the calcination of the mineral having been exactly weighed, we heated by an enameller's lamp the part of the platinum crucible containing the boat and the substance to be analysed. Slight vapours were disengaged and condensed inside the glass tube, but on weighing this tube it was found to have increased in weight scarcely one milligramme.

In another experiment we did not pulverise, but broke up the mineral into fragments, which when treated in the same manner decrepitated and projected into the condensing tube a brown powder of great tenuity without apparently disengaging more moisture than in the preceding experiment. According to these results parisite would hold no water in combination. The presence of the 2.50 per cent. of water found by M. Bunsen may be explained by admitting the accidental interposition of the liquid in some of the interstices of the mineral. On breaking parisite crystals we find, in fact, in their interior small hollows lined with microscopic crystals. It is possible that in these cavities infinitesimal quantities of water were interposed, which would disappear when the mineral was reduced to impalpable powder.

The apparatus described as having served in the research for water in parisite had been previously employed successfully in determining the water in minerals containing but a very small proportion of it, such as euclase, idocrase, diallages, talcs, &c. It has the advantage of rendering visible the water disengaged from minerals by heat, and of allowing it to be transferred so as to undergo various tests.

The mean of these analyses has given the following numbers:—

		Oxygen.	Relation.
Carbonic acid	. . 0.2348	0.1708	6
Cerous oxide	. . 0.4252	0.0699	2
Oxide of didymium	. . 0.0958	0.0137	1
Oxide of lanthanum	. . 0.0826	0.0121	
Lime.	. . 0.0285	0.0081	
Manganous oxide	. traces		
Fluoride of calcium	. . 0.1010		
Fluoride of cerium	. . 0.0216		
		0.9895	

Parasite, then, may be represented by the formula,—



—*Comptes Rendus*, lix., 271, 64.

TECHNICAL CHEMISTRY.

Carburation of Iron by Contact or Cementation, by M. FRED. MARGUERITTE.

THE theory of the carburation of iron has been the subject of many controversies. Not wishing to discuss all the opinions relating to this subject, I have simply sought to ascertain whether carbon combines with iron directly by contact or by cementation.

Guyton-Morveau (*Annales de Chimie et de Physique*, series 1, xxviii., 19) was the first who attempted to prove that alteration takes place by simple contact. He calcined a diamond in an iron crucible placed in a Hessian crucible. After undergoing about an hour of intense heat the iron crucible was completely changed into a mass of melted steel.

Thus, says Guyton-Morveau, the diamond disappeared by the attractive force of the iron favoured by the high temperature to which they were both exposed, just as one metal disappears in forming an alloy with another metal.

Nevertheless, the transformation of iron into steel exclusively by the contact of the diamond may be contested, as the iron crucible during the whole time of calcination was exposed to the carburising action of the gases of the furnace. The question seems as yet unresolved; and M. Chevreul recently said before the Academy (*Comptes Rendus*, 1861, lii, 424):—

"It is important to know, 1. Whether it is true, as Guyton says, that iron may be converted into steel with diamond powder; 2. Whether, if such be the case, the transformation is effected without the intervention of nitrogen."

The object of this paper is to show that iron carburises, is converted into cast iron when heated in contact with carbon, and is also transformed into steel without the intervention of nitrogen. The essential conditions of the experiment are carried out as follows:—I operated—

1. With pure carbon (diamond);
2. In an atmosphere of chemically pure hydrogen;
3. In vessels absolutely impermeable to the gases of the furnace;

So that the possible combination of the diamond and iron was complicated by no foreign action.

The experiment was thus effected:—Hydrogen was prepared with distilled zinc, and pure sulphuric acid, purified and dried with the greatest care, in the way indicated by MM. Dumas and Sainte Claire Deville; that is to say, that the gas traversed successively apparatuses filled with acetate of lead, sulphate of silver, pumice stone saturated with potash, and cold sulphuric acid, after having passed through spongy platinum heated to dull redness.

Thus purified and dried the hydrogen was carried through a doubly glazed porcelain tube, whose perfect impermeability had been tested, which was heated to the melting point of cast iron. In the tube was a small porcelain boat, on the edges of which rested a very fine plate, which had been previously and for a long time heated in a current of hydrogen, so as to free it from its sulphur and nitrogen.

On the iron plate was placed a diamond which had been slightly heated; a cold hydrogen current was passed through the apparatus for several hours, to free it from air,—that is to say, from oxygen and nitrogen. The temperature was then rapidly raised to red heat, and kept at this point for some time. The tube was

then taken from the furnace and cooled, remaining in the hydrogen current.

It was found that the diamond on the iron plate had made a hole, as if with a puncher, whence it had fallen into the boat beside a small globule of cast iron.

In the second operation five small diamonds traversed a soft iron plate, and in disappearing gave well melted globules of cast iron.

In the third experiment a larger diamond and a thicker iron plate were used. The diamond pierced and became inserted in the plate.

Then a fourth experiment was made for the purpose of producing steel.

The hydrogen current was directed on an iron wire $1\frac{1}{2}$ millimetre in diameter, half of which was covered with coarse diamond powder contained in a platinum boat.* The part of the wire plunged in the diamond dust was cemented, while the rest of it remained unaltered.

After having used diamond, we operated on plumbago and sugar charcoal calcined for a long time in a hydrogen current.

After heating strongly the tube containing the charcoal, an iron wire was introduced into it $1\frac{1}{2}$ millimetre in diameter. In three minutes the end of the wire in the carbon dust was transformed into cast iron, the globules of which were found. The temperature was lowered, and in the same space of time the extremity of another wire was converted into very hard fine-grained steel, while the part not in immediate contact with the charcoal showed no sign of any change. This confirms M. Berthelot's observation that if hydrogen were capable of forming acetylene or any other carbonised compound, the whole of the wire would have been cemented.—*Comptes Rendus*, lix., 139.

PHARMACY, TOXICOLOGY, &c.

On a Means of Detecting Nitro-benzol in Oil of Bitter Almonds, by M. DRAGENDORFF.

THIS test consists in acting on the adulterated oil with sodium in the presence of alcohol. This metal, in contact with pure oil of bitter almonds, disengages gas, which is augmented by the addition of alcohol, and white flocks are formed. Nitro-benzol under the same circumstances with alcohol becomes deep brown or black and viscid.

In testing the adulterated oil, take ten or fifteen drops of it, add four or five drops of alcohol, and a fragment of sodium; a brown deposit, approaching black, in proportion as the nitro-benzol is in excess, occurs. This reaction is instantaneous, and when the oil contains from 30 to 50 per cent. of nitro-benzol one minute is sufficient to obtain a thick brown liquid.—*Journ. de Pharm.*

On a New Falsification of Saffron, by M. GUIBOUT.

M. VESQUE, Pharmacien of Lizieux, has received recently from a house in Paris, under the name of "*Safran du Gatinais*," 250 grammes of a saffron of inferior quality, containing about 30 per cent. of a material judged to be the stamens. Professor Decaisne, who has examined this substance, has recognised in the length of the filaments the cylindrical form of the anthers and the large size of the pollen grains, that these stamens are those of a *Crocus*. But they are not the

* Several good diamonds were pounded in a steel mortar, the powder boiled in nitric acid to free it from any metallic particles, and then slightly heated.

stamens of the mother plant, which have been inadvertently collected with the stigmata, the colour of which is yellow and easily distinguishable. They are evidently collected intentionally, dyed artificially, and twisted so as to deceive the eye, and in quantity equal to nearly a half of the article. The adulteration is recognised by throwing a certain quantity into a glass of water. The stamens are instantly decolorised and float, whilst the true stigmata fall to the bottom of the water. On comparison with the figures of Hayne, these stamens belong to the *Crocus vernus*, by the cylindrical form of their anthers, rounded at the summit, whilst the anthers of *Crocus sativus* are terminated like an arrow. Finally, this saffron contains also little marigold petals, coloured red like the stamens; these sink in water with the stigmas of the saffron, and are recognised by their base, their longitudinal nervures, and three-pointed terminations. I do not know what opinion to give of a merchant who thus falsifies saffron; the man who takes your purse from your pocket is not more culpable.—*Journ. de Pharm.*, Juin., 1864.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 3.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,
in the Chair.

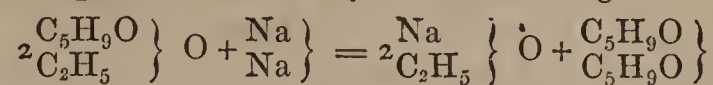
At this the opening meeting of the Society during the present session there was an unusually large attendance of members, and a sufficient amount of business to occupy the Society until a very late period in the evening.

The minutes of the last ordinary meeting (in June) having been read and confirmed, and a very long list of library contributions acknowledged, Mr. Wm. Baker, of Sheffield, and Mr. G. W. Knox were formally admitted as Fellows of the Society. The names of several candidates for the same honour were then read over for the first time; amongst them were Colonel H. Y. D. Scott, Royal Engineers, South Kensington Museum; Lieutenant Hosier, 2nd Life Guards; Dr. Hermann Sprengel; Mr. John Berger Spence, Manchester; Mr. J. G. F. Richardson and Mr. Daniel Harvey Jay, Leicester; Mr. Henry Haywood, Broom Hall Park, Sheffield; Mr. Charles Eken, Bath; and Mr. William White Rouch, Norfolk Street, Strand.

The PRESIDENT then read a resolution of the Council to the effect that the names of several members of the Society who had allowed their subscriptions to lapse for the three last years be removed from the list of Fellows. After the third reading of this resolution it was proposed to ascertain the feeling of the Society with regard to it by ballot.

A paper was read by Professor WANKLYN "*On Valeryl, the Radical of Valerianic Acid.*" The author began by referring to some very old researches of Löwig and Wiedemann, wherein it was shown that when acetic ether is acted upon by potassium or sodium it does not evolve ethyl, but gives ethylate of sodium and other products. According to the prevalent opinion, acetic ether should yield ethyl just as iodide of ethyl yields ethyl when it is acted upon by a metal. Mr. Wanklyn had repeated Löwig and Weidmann's experiment with acetic ether, and confirmed their result in so far as the non-evolution of ethyl was concerned. With valerianic ether and sodium or potassium he got likewise no evolution of ethyl. From a review of the chief reactions of acetic ether, Mr. Wanklyn came to the conclusion that it was more correctly described as ethylate of acetyl than as acetate of ethyl. Of course, the same would apply to other ethers, and thus valerianic ether should be ethylate of valeryl. Experiments made

with sodium and valerianic ether gave this result. One molecule of valerianic ether is decomposed by one atom of sodium yielding one molecule of ethylate of sodium and one equivalent of valeryl. Or doubling—



In the experiments described, a weighed quantity of valerianic ether was sealed up with a weighed quantity of sodium and some dry common ether. After action in the water bath the tube was opened, no gas escaped. The residual unacted upon sodium was then cleaned and weighed; the difference between this weight and the weight of the sodium taken gave the sodium actually consumed. The amount of ethylate of sodium formed was determined by titrating the caustic soda produced by reaction with water. It was found that the quantity of valerianic ether taken, the quantity of sodium consumed, and the quantity of ethylate of sodium formed were what the above equation requires. The oil formed had the composition of valeryl. In conclusion the author promised to make a minute examination of valeryl, and of several of the acid-forming radicals, and remarked that the result of the research was the disclosure of a new general law in organic chemistry.

An explanation of the formation of carbonic ether from oxalic ether was also given.

The PRESIDENT remarked upon the unexpected nature of the reaction discovered by Professor Wanklyn; he should rather have anticipated the elimination of hydrogen; the formation of the acid radical in this simple manner was a fact of great interest and importance.

Dr. FRANKLAND made a similar remark, and inquired of the author whether he had yet tried the action of chlorine upon the radical? The speaker was now engaged conjointly with Mr. Duppa in a somewhat similar line of research; the experiments were not, however, sufficiently advanced to enable him to make a statement on the present occasion.

Professor WANKLYN, in reply to Dr. Odling, said that he had not yet succeeded in making the valeryl-sodium; and that time had not permitted of his examining fully the action of chlorine; so far it appeared to be split up into a hydrocarbon and a valerate.

The PRESIDENT next called upon Mr. William Baker, of Sheffield, to give an account of some experiments made by himself and Mr. Graham Stuart "*On the Existence of Nitrogen in Steel.*"

This research was directed to the repetition of M. Fremy's investigations, using, however, the characteristic varieties of Sheffield steel, Bessemer steel, "J. B." iron, and other British brands, besides the well-known Spiegeleisen now largely used in the manufacture of steel. A full account of these results must unavoidably be deferred until next week, but it may be stated at once that the important conclusion to which the authors have arrived is to the effect that there is no clear evidence of the existence of nitrogen in steel, nor in any of the brands of iron which they have examined. The authors referred incidentally to the possible existence of the nitride of titanium in steel and titaniferous iron, which might under such special circumstances account for the appearance and detection of nitrogen amongst other normal constituents.

Mr. WILLIAM BAKER, Associate of the Royal School of Mines, then read the following paper, entitled "*On the Occurrence of Nickel in Lead, and its Concentration by Pattinson's Process.*"

It is well known that for certain manufactures lead of a high degree of purity is required. The presence of a very small amount of copper especially is injurious for making white lead and glass makers' red lead. Investigating the cause of a peculiar tint in glass which was sometimes sufficiently marked to be called blue, and was readily accounted

for by the presence of copper, I sought carefully for cobalt, but only found nickel. In all the samples of English lead which I have examined I have never detected a trace of cobalt. On the contrary, traces of nickel have frequently been found in various samples of Derbyshire lead, in Yorkshire lead, and lead from Snailbeach, Shropshire. Operating upon 2000 grains I have found the following quantities of nickel in the pig lead as delivered by the smelter:

	Per cent.	ozs.	dwts.	grs.	
Derbyshire lead, 1st sample	0.0023 = 0	14	8		per ton.
„ „ 2nd „	0.0031 = 0	19	14		„
„ „ 3rd „	0.0023 = 0	14	8		„
Snailbeach lead . . .	0.0007 = 0	5	10		„
Softened slag lead . . .	0.0057 = 1	16	14		„

On submitting lead containing these quantities of nickel to Pattinson's process, I find a concentration of the nickel in the fluid portion. Crystals of lead were taken out in the proportion of 9-10ths, leaving 1-10th fluid lead of a five ton charge.

Samples of the fluid lead, or "bottoms," upon analysis, contained nickel as follows:—

	Per cent.	ozs.	dwts.	grs.	
After 3 crystallisations .	0.0047 = 1	10	1		per ton.
„ 1 „	0.0043 = 1	7	10		„
„ 1 „	0.0062 = 2	0	12		„
„ 2 „	0.0072 = 2	7	0		„

In all cases a weighable quantity could be obtained from 2000 grains of lead.

Five tons of lead contained 0.0068 = 2 4 10 per ton. Four and a-half tons were removed as crystals, and when

melted contained only 0.0047 = 1 10 1 per ton. These figures show that nickel remains to a great extent with the fluid portion, much as copper does, and I have reason to suppose that when it reaches a certain amount, as in the case with copper, the separation is no longer effected, or only in a very small degree. In the case of copper, this is easily understood when it is seen that, at a low temperature, copper (in the absence of antimony and arsenic) will separate and be found in the dross on skimming, leaving the fluid lead containing about 20 ozs. per ton = 0.06 per cent. To effect a separation of the copper by Pattinson's process the amount at the commencement should not be more than 10 ozs. per ton.

A sample of lead from five tons, when analysed, gave no indications of the presence of nickel; on crystallising 9-10ths, the remainder gave distinct traces of the metal. In refined lead I have only once succeeded in obtaining a weighable quantity, and only rarely found traces in nickel. That it is not removed by oxidation is proved by the larger quantity found in the fluid portion of the lead when crystallised, as well as by the fact that in the softened slag lead which is submitted to the powerful oxidising action of nitrate of soda a considerable quantity of nickel is still found.

Professor A. H. CHURCH then read a paper "*On the Blue Colour of Forest Marble*." This rock, which is a well known member of the oolitic series, is externally of a fawn colour, but always contains a darker-coloured, bluish grey interior portion, to which the author's remarks particularly referred. The common explanation was to the effect that the iron, existing to the amount of about one per cent., was in the form of protoxide in the interior and peroxidised without; but a more critical examination showed that the blue colour was due to the occurrence of bisulphide of iron, which had become converted in the external portions into a soluble sulphate of iron, which, reacting upon the carbonate of lime in the presence of air, formed sulphate of lime and hydrated peroxide of iron. The analytical examination proved that sulphur existed wholly as sulphate of lime in the external crust, whilst, by digesting the blue interior mineral in dilute hydrochloric acid, an

insoluble residue remained, which was composed, to the extent of 16 per cent., of bisulphide of iron, and there was some sulphate of lime in solution. By mixing together iron pyrites and carbonate of lime, both in the state of very fine powder, the author succeeded in imitating the bluish tint of the natural rock.

Professor Church then proceeded to give an account of some experiments he had lately been making upon "*The Effect of Ignition on Garnets, &c.*" In the *Proceedings* of the Royal Society, vol. xiii., p. 241, would be found recorded some extraordinary statements tending to show that certain minerals of the idocrase and garnet family underwent expansion when exposed to a red heat, but only went back again to their normal dimensions after the lapse of a month or other considerable period of time. That, in fact, the specific gravity of lime garnet, originally 3.35, was reduced to 2.98 by being heated to redness for a quarter of an hour, and allowed to cool; and that the mineral being left at rest for a month regained its original density. Professor Church then proceeded to challenge the accuracy of these observations, and described the results of his own experiments upon the same minerals, by which it was proved that in no single instance was there any indication of the "intermittent molecular change" which the author lays claim to having discovered. Amongst the numerous results brought forward by Mr. Church were the following:—

	Original Density.	Density after being Heated to Redness and Cooled.
Idocrase	3.384	3.385
Do. (another specimen)	3.400	3.401
Brown-red iron garnet	4.058	4.045
Iron garnet	4.130	4.050
Lime garnet	3.666	3.682
Olivine	3.389	3.378

The specific gravities of beryl, chrysoberyl, and topaz were likewise identical before and after ignition. Many of these minerals became *permanently* reduced in density by the action of a temperature sufficiently high to cause fusion. Thus, the specimen of idocrase originally 3.40 was diminished to 2.937 by fusion, and the brown-red iron garnet from Arundel became reduced to 3.395, and even to 3.204 by longer fusion. It is well known that heat is sometimes employed as a means of altering the colour and imparting increased brilliancy to natural gems. A large Indian zircon in the possession of the speaker, which weighs between 2 and 3 grammes, has a specific gravity = 4.696—a number not widely different from 4.534, which M. Damour obtained by heating to redness a natural zircon of original gravity 4.183. Mr. Church concluded by stating his conviction that the remarkable assertions communicated to the Royal Society in May last were not founded upon correct observation, and before publishing this as his final conclusion he had made upwards of seventy experiments, so that it is obvious there must be some occult cause for results so anomalous. It must be admitted, however, that he (Mr. Church) failed to comply with some of the conditions set forth by the author, viz., "The diminution of density being noted, the specimens were carefully dried, enveloped in several folds of filtering paper, and put aside in a box *along with other minerals*."

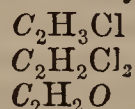
Mr. PERKIN having suggested that the anomalous gravities might be accounted for by the specimens having been weighed whilst yet warm, the meeting was adjourned by the President until the 17th instant.

The name of the author was not mentioned by Professor Church. On turning to page 240 of the *Proceedings* of the Royal Society, vol. xiii., we find a "*Note on the Variations of Density produced by Heat in Mineral Substances*," by Dr. T. L. Phipson, F.C.S., &c. Communicated by Professor Tyndall.

LECTURES ON CHEMICAL PHILOSOPHY.—VI.

Delivered at the College of France, by M. A. WURTZ.
The Theory of Types.

THE idea of types flows naturally from the theory of substitutions. We discover the germ of it in the derived radicals which are brought into relation with a fundamental radical. It is in this way that the radicals



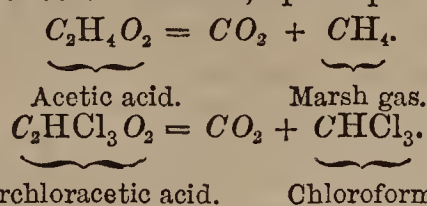
are related to the fundamental radical



from which they are derived by substitution. All these nuclei belong to what has been since named the *mechanical type*.

But strictly speaking the theory of types only begins with the study of the chlorinated derivatives of acetic acid by Dumas.

Dumas discovered that in the acid $C_2H_4O_2$ we can substitute Cl_3 for H_3 , and so form the acid $C_2HCl_3O_2$. Having compared the properties of these two bodies, he found that both were powerful monobasic acids, and that both, under the influence of alkalis, split up in the same way.



In a word, Dumas recognised that acetic acid and terchloroacetic acid, which are derived one from the other by the substitution of Cl_3 for H_3 , and which contain the same number of atoms, grouped in the same manner, possess also the same fundamental properties. He expressed these facts by saying that these two acids belonged to the same chemical type. He endeavoured also to demonstrate that the chemical properties of a compound depend less upon the nature of the constituent elements than upon the way in which these elements are grouped. Chlorine, he said, although endowed with properties quite opposite to those of hydrogen, may be substituted for the latter in a compound without modifying its fundamental properties, because the grouping may remain the same.

This was a novel and bold idea, and perhaps rather exaggerated in form, for certain facts of substitution which have been discovered since have demonstrated that the properties of bodies depend at once upon the nature of the atoms and the manner in which they are grouped.

Regnault came afterwards bringing the idea of mechanical types, and placing in the same group all bodies which contain an equal number of atoms, whether their fundamental properties are the same or not.

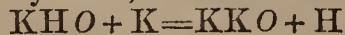
The idea of types enunciated for the first time by Dumas was true and fruitful: it bore a germ capable of immense developments; but in its first form it was susceptible of no great extension.

It regards each primitive compound as a particular type to which all the bodies derived by substitution are related. The number of types was too great, so the theory needed at the same time extension and simplification. And thus we soon see it assume a new form, and by becoming allied with the fundamental principle of atomicity, its value is doubled.

Laurent was the first who compared hydrate of potassium with water. He showed that hydrate of potassium results simply from the substitution of one atom of potassium for one atom of hydrogen in a molecule of water.

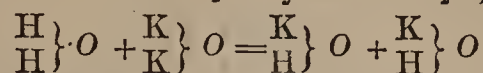


If we take this hydrate, and treat it with potassium, we have



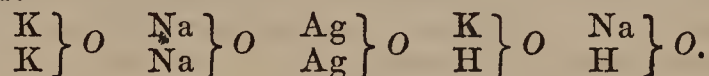
KKO or K_2O is anhydrous potash: it only differs from water by the substitution of K_2 for H_2 .

If we treat this oxide K_2O by water H_2O , we shall have

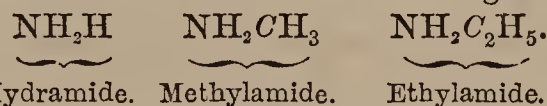


Thus in these reactions hydrate of potassium and oxide of potassium are derived from water directly by substitution.

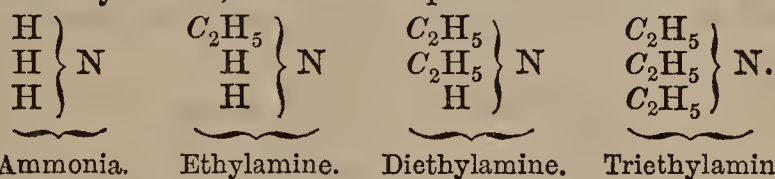
Generalising upon these facts, Laurent compared the anhydrous oxides and the hydrates to water. The potassic, sodic, and argentine oxides, and the potassic, &c., hydrates also belong to the type of water, and their formulæ are similar.



The idea of an *ammonia type* arose out of my own studies and those of Hofmann on the compound ammonias. In the communication in which I announced the discovery of compound ammonias, I remarked that these bodies might be regarded as ammonias in which one equivalent of hydrogen is replaced by methylum or ethylum. I represented these relations in the following way:—



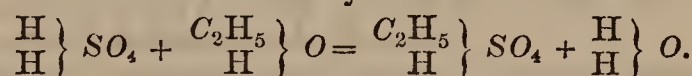
A few months later Hofmann discovered diethylamine and triethylamine, which he represented thus:—



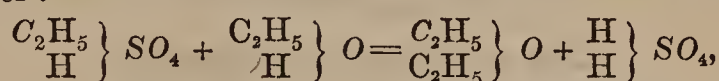
He thus formulated the typical idea more clearly than I had done it myself.

The ammonia type was adopted by chemists without difficulty, but still only from an isolated point of view; the doctrine was not yet constituted in its entirety. Towards this end the labours of Williamson gave the most decisive movement. These labours relate to etherification and the constitution of ethers.

When sulphuric acid, H_2SO_4 , reacts on alcohol, C_2H_6O , sulphovinic acid is formed by a double substitution.

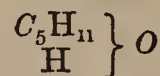


Williamson has shown that ether is formed by the action of sulphovinic acid on alcohol in the following manner:—



which shows us that ether contains two ethylic molecules. This fact has been definitely proved by the discovery of mixed ethers.

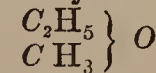
Williamson by the action of sulphovinic acid on amyl alcohol—



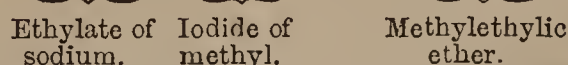
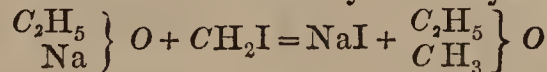
reproduced the sulphuric acid, and formed an ethylamylic ether—



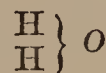
He has also obtained an ethylmethylic ether—



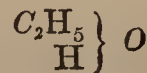
by the reaction of iodide of methyl on ethylate of sodium



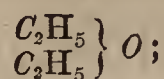
The eminent chemist saw at once the import of his discovery. Water being



alcohol must be

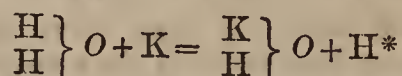


and ether

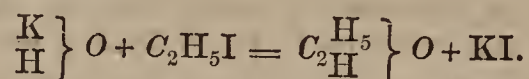


which is the same as saying that alcohol only differs from water by having (CH_5) substituted for H, and ether only differs from water by having $(C_2H_5)_2$ substituted for H_2 . And this is not a purely theoretical view; we can really effect these substitutions, and follow them, so to speak, step by step.

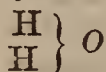
When we throw potassium into water, one atom of hydrogen will be displaced, and potassic water or hydrate of potassium, will be formed.



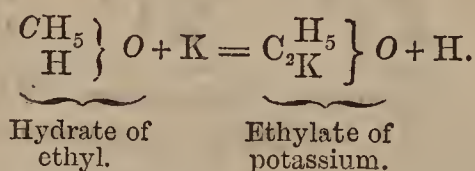
If, now, we heat together an alcoholic solution of hydrate of potassium and iodide of ethyl, hydrate of ethyl and alcohol are formed—



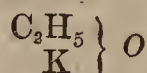
Thus, just in the same way as in ordinary water



we can replace H by K, so in the ethylated water or alcohol we can likewise turn out the atom of hydrogen by potassium—

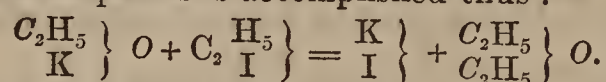


We can now replace K in



by the group C_2H_5 , and so arrive at ether. To effect this it is only necessary to heat ethylate of potassium with iodide of ethyl— C_2H_5I .

The metamorphosis is accomplished thus:—



We thus see that ether really contains two ethylic molecules, since we can add one after the other, and so prove the series of the phenomena indicated above.

(To be continued.)

PHARMACEUTICAL MEETING.

Wednesday, November 2.

Mr. HILLS, Vice-President, in the Chair.

ON commencing the business of the evening, the CHAIRMAN called attention to a "*Poison Bottle*," which was exhibited to the meeting. The novelty consisted in a metal cap which covered the stopper, and was retained in its position by two spring clasps, which grasped the neck of the bottle. By pressure on two pins the clasps were withdrawn, and the cap could be removed.

Professor BENTLEY shortly noticed some specimens of materials used for scenting teas in China, presented to the Society by Messrs. Piesse and Lubin. These are mixed with tea, and the two are allowed to remain in contact for a longer or shorter time, after which the perfumed material is sifted out.

Professor BENTLEY then read a short paper by Dr. W. F. Daniell, "*On the Production of Hydrocyanic Acid from Bitter Cassava Root*." The writer said that prussic acid was first found in the juice of cassava root by two French chemists in 1836, and the fact had subsequently been confirmed by Christison. The investigations for the present paper had been made by Mr. Hughes, a young creole

chemist, who had pursued his studies under great difficulties. The circumstance that hydrocyanic acid was found in plants growing in tropical climates, the author considered as deserving attention, since it was known that the ordinary acid would not keep in hot climates. It soon changed into a carbonaceous liquor, which had neither taste nor odour. Recently, a quantity of imported acid had been condemned as worthless at the Military Depot in Kingston, Jamaica. There are two sorts of cassava root, known as the bitter and the sweet. No botanical differences are recognisable, but the negroes know how to distinguish between them. It seems to be doubtful (as we gathered from the paper) whether or not the root is poisonous when first dug up. Hogs and poultry, it was said, then feed on it with impunity, eating the red earth in which the plant grows as an antidote. But when the cortical portion of the root is stripped off, and it is exposed to air, a kind of fermentation sets up, and the juice is converted into a virulent poison. (A sample of the juice, which had a scarcely perceptible odour of prussic acid, was handed round, together with another bottle containing a distillate from the juice. The latter had a much more pronounced odour of hydrocyanic acid.) In time it would appear the acid is dissipated by evaporation, and the starch is then washed out of the roots. The bitter cassava is cultivated in Jamaica for the starch which is sold in Kingston market to adulterate arrowroot. In Western Africa Dr. Daniell wrote, the negroes put the root on the fire to drive off the poison, and make an alcoholic drink by fermenting the starch. Professor Bentley added that the interest of the paper consisted in the proof it gave that a deadly poison like prussic acid was yielded by a root which also yielded two such valuable substances as arrowroot and tapioca. Two plants were cultivated to furnish these, the bitter and the sweet cassava—one poisonous, the other quite innocuous. The roots of these showed no botanical differences, but certain physical differences of much interest were easily remarked.

Mr. MORSON said the odour of hydrocyanic acid was very distinct in the distillate from the juice. The acid was probably formed by a kind of fermentation.

Dr. EDWARDS remarked on the fact that the red earth was considered an antidote for the poison. It probably contained oxide of iron, which was an antidote for prussic acid.

Dr. REDWOOD said that the paper did not add much to our knowledge of the subject. The facts related were trifling, and the paper did not inform us how the prussic acid was obtained from the juice, nor the quantity it yielded. We were still in the dark as to what the poisonous effects of cassava root were due. They might perhaps be due to something else than prussic acid, which acid was probably found under peculiar circumstances. The acid, it had been shown, could be found from a variety of vegetable substances, apple pips among others.

Professor BENTLEY said the paper did not pretend to indicate the poisonous principle of cassava. It was only confirmatory of a previous assertion.

Mr. A. F. HASELDEN then read a paper "*On the Extracts of the British Pharmacopœia which are Prepared from Dry Material*." The author commenced by remarking that up to the present there had been no discussions on the British Pharmacopœia at the meetings of the Society, and he thought the time had arrived when the experience of pharmacutists with the new processes might be brought before the meeting, and useful conclusions be drawn as to the value of the formulæ. The paper now brought forward would, he hoped, be one of a series in which he intended to lay before the Society the results of his own experience with one important class of medicines. The first extract he would notice was extract of Calumba. This extract is new to the British pharmacist, and is taken from the Prussian Pharmacopœia. It is directed to be prepared by

* In order to avoid a useless complication, the author has not doubled this and the analogous equations.

macerating one pound of Calumba root in powder with two pints of proof spirit for twenty-four hours; after which the material is to be percolated with two more pints of spirit; the tincture is then to be distilled to recover the alcohol, and the residue evaporated to a proper consistence. This process, the author said, was extremely wasteful. No directions were given either for displacing the whole of the spirit or for pressing the marc, and consequently, if the directions of the Pharmacopœia were closely followed, one-half the extract obtainable was lost, and one-fifth of the spirit remained absorbed by the marc. Moreover, the extract when finished was a tough leathery mass, by no means convenient for use, and which now costs two shillings an ounce. The yield of extract by the Pharmacopœia process was only one and a-half ounce from a pound of the root. Mr. Haselden thought that there could be no objection to displacing the whole of the spirit by means of water; the product could not be injured by the admixture of a little water with the tincture. But was spirit necessary for the production of a good extract of Calumba? The bitter principle of the root was readily soluble in cold water, and by percolating the root with cold water two ounces and a-half of good extract might be obtained from a pound of Calumba. By using boiling water the yield was further increased to three and a-quarter ounces, but an objection was made to an extract so made on the score of its containing starch. Mr. Haselden considered the presence of starch rather advantageous than otherwise, since it gave consistence to the extract, and might also be useful in a therapeutical point of view, in support of which latter opinion he read an extract from Pereira's "Materia Medica."

The discussion was opened by Mr. MACKAY, who led it completely away from the subject of the paper by asking if any one present knew how the extracts shown by M. Berjot in the Exhibition of 1862 were made?

Professor REDWOOD said that the extracts alluded to were extremely beautiful to look at, but not at all adapted for ordinary pharmaceutical use. While kept perfectly dry they resembled tannic acid somewhat in appearance; but were so hygroscopic, that on the slightest exposure to moisture they shrank into a dirty mass. This defect of readily absorbing moisture, the Professor remarked, was common to all extracts prepared from vegetable juices when the chlorophyll was separated. The clear juice of conium gave an extract which, in a few weeks, became as thin as treacle. The cause of this was probably the deliquescent nature of the salts contained in this and similar juices. When the chlorophyll was returned to the extract it might perhaps protect these salts from the moisture of the atmosphere, in the same way that starch prevents chloride of calcium from deliquescenting.

Mr. HANBURY agreed with Dr. Redwood that the French extracts were not worthy of imitation. Though beautiful in appearance they were so prone to absorb moisture that it was practically impossible to keep them.

Mr. HASELDEN then made another communication "On the Extract of Liquorice" of the British Pharmacopœia. After comparing the process of the British with past Pharmacopœias, the author said the present process was expensive and defective on some points. The amount of water to be added to the coarsely powdered root was not sufficient for maceration; the mixture, when made, was apt to ferment in a warm place, and moreover, it packed very badly in a percolator. With the addition of more water in the preliminary maceration the process would answer very well and yield a very good extract, but at a cost of 4s. 6d. per lb. The author did not object to the cost of a medicine when commensurate advantages were obtained, but in the present instance he considered that a process of his own yielded an equally good extract at a smaller cost. He took the larger fresh roots of liquorice, bruised them with a mallet, cut them into convenient lengths, and then placed them in a copper with three pints

of water to every pound of root. Heat was now applied, and the decoction was just allowed to simmer. After standing all night, the decoction was run off in the morning and strained through a canvas bag, after which it was evaporated to one-third of its bulk. The process was repeated with the root, and this decoction was evaporated like the first; the rich liquor was added to the poor towards the end of the evaporation, and thus a long application of heat to the former was avoided. In this way he obtained from the fresh root 22 per cent. of a good sweet rich extract, which was quite soluble in water, and left no deposit on standing. The cost of this extract was 3s. per lb. A larger amount of extract was procured when the decoction was strained whilst hot. The fresh root then gave 35 per cent. of extract (at a cost of 2s. per lb.) which contained mucilage and other matters, but was useful for making lozenges. This extract was not quite soluble in cold water, and becomes dark on keeping.

Specimens of extracts made by all the processes named were handed round.

Mr. HILLS said the papers read were of a very useful practical character, and deserved the thanks of the meeting. He considered the extract made by the Pharmacopœia process the best.

Mr. MORSON, on the contrary, thought that made when the decoction was strained hot was the best.

Mr. UMNEY said that the Pharmacopœia process would not answer on the large scale. The method pursued by wholesale manufacturers was as follows:—The coarsely-powdered root was placed in a large barrel, and wetted with water. After standing twenty-four hours the liquor was drained off, and the marc pressed. The extract was then finished according to the Pharmacopœia. If the root was left in contact with the water more than twenty-four hours, fermentation was very likely to be set up. The amount of extract obtained by this process was greater than that procured by Mr. Haselden in following the Pharmacopœia directions.

Mr. GROVES thought the extract made from the dried roots was inferior to that made from the fresh; it had an acrid taste, which was objectionable.

The meeting then adjourned until Wednesday, December 7th, when a paper "On the Gamboge Tree of Siam" will be read by Mr. Daniel Hanbury, F.S.S.

ACADEMY OF SCIENCES.

October 31.

M. BECQUEREL contributed a memoir "On the Preservation of Iron and Cast Iron in Soft Water." Our readers will remember that a month or two ago the author announced that iron-plated vessels could be preserved from oxidation by fixing bands of zinc over the iron plates at intervals. It seems that in soft water the protection is not so complete, and a larger surface of zinc is required to ensure perfect preservation. The present memoir is devoted to a statement of the electric condition of the plates, which shows that in salt water the current set up at the point of contact of the two metals extends a long distance, and that the intensity diminishes very slowly. In soft water, however, the intensity diminishes rapidly; nevertheless, the protection may be made complete, as we have said, by the use of a larger surface of zinc. The author found that 9387 cannon balls of 12 centimetres diameter under soft water required for their protection bands of zinc having a surface of two square metres. M. Becquerel makes another suggestion for the protection of water pipes of cast iron in wet earth. If these should prove sufficient conductors they might be protected for great distances, and it would only be necessary to have openings at intervals to allow of the zinc being got at for the surface to be cleaned.

M. Isidore Pierre contributed the first part of a second memoir "On the Development of Corn." The present part

relates to the increase in the weight of the different parts of the ear, which takes place in the period between the termination of the flowering and the time of gathering the corn. This period in the author's experiment this year lasted nineteen days. During this time the whole ear increased 80 per cent. in weight. At the same time the stalk and husks of the ear are undergoing a progressive diminution of weight, while the grain constantly goes on increasing. Passing over the stalks and husks, we may note the circumstance that the dry matter in a kilogramme of grains increased from 329.5 grammes to 616.2 grammes during these nineteen days. Another curious fact is, that while on July 6 the mineral substances in the grain amounted to 25.579 grammes per kilogramme, the amount on July 25 had diminished to 19.54 grammes per kilo. The nitrogen in the same time had increased from 18.29 grammes to 22.81 grammes. The author seems to think that the grain is nourished at the expense of the upper part of the stem of the plant.

M. Magueritte continues his apparently interminable dispute with M. Caron as to the agent which produces the cementation of iron. He sticks to the point which the reader will see in another paper we publish to-day—namely, that it is either carbon alone or carbonic oxide which produces steel, and that practically cyanogen alone will not effect the change.

M. Hautefeuille communicated another note "*On the Titanates and Some Silicates.*" The author described the way in which he formed monobasic titanates of lime and magnesia, and bibasic titanates of lime, iron, and manganese, and also corresponding silicates. The natural tendency of both silica and titanate acid, it seems, is to form monobasic compounds with lime and magnesia, and bibasic with magnesia, iron, and manganese.

NOTICES OF BOOKS.

Elements of Materia Medica: containing the Chemistry and Natural History of Drugs; their Effects, Doses, and Adulterations, &c., &c. By Dr. W. FRAZER. London: Churchill and Sons. 1864. Second Edition.

THE study of the materia medica and therapeutics is by no means popular in the Medical Profession. Lectureships on the subject generally fall into the hands of junior physicians, who must lecture upon something. Students get up the chemistry and botany of the Pharmacopœia for the examinations, and having passed them, straightway forget both, remembering for the most part only such simple facts concerning remedies as that opium is a sedative, senna and calomel are purgatives, and ipecacuanha an emetic, expectorant, diaphoretic, &c. As they get on in life, most men acquire some peculiar views relative to the action of medicines, and thus their treatment of disease becomes day by day more and more empirical.

By a natural reaction against the exclusive reliance on medicines which up to recent times characterised the practice of the healing art, there is a now wide-spread scepticism as to the value of remedies altogether. The effect of this, we fear, is to be seen in our works on Materia Medica. They are becoming more and more simple manuals by which to get up the subject for the examinations. Some are cut down to "the Essentials." The three goodly-sized volumes of Pereira, in which that great teacher only professed to give the "Elements" of the subject, are, we understand, undergoing a similar process of evaporation and concentration to one small volume. Perhaps this is to some extent unavoidable. A medical student has so many subjects "to get up" in these days, that it is impossible for him to give much attention to more than one or two, and therapeutics is not one of these. Still it might be thought that a knowledge of the action of remedies was of sufficient importance to make it a promi-

nent subject in the course of preparation for Medical practice. Such, however, does not seem to be the opinion of those who ought to know more about these matters than we do.

With regard to Dr. Frazer's book. It is just such a book as is in demand now. The author is an experienced teacher, and has been an examiner on the subject, and knows well what medical students are expected to know. The botany and chemistry are not so much dwelt upon as by some writers on the subjects, but the account of the effects of remedies is fuller, which is a decided recommendation to the book. We may also say a word in praise of the external getting up of the book. It is issued with cut edges, as we should be glad to see all books issued.

Skin Diseases; their Description, Pathology, Diagnosis, and Treatment. With a copious Formulary. By TILBURY Fox, M.D. Lond., &c., &c. London: Hardwicke. 1864.

WE do not know what the medical profession will have to say to this work, but it seems to us to have one great want. It is quite destitute of illustrations, and a book on skin diseases without coloured plates appears to us as absurd as a book on flowers without the same kind of illustrations. For a student such a book must necessarily be useless. Apart from this want, however, the book is very good. The verbal descriptions of the appearances of skin diseases are as good as they could be, and the etiology and treatment of the various affections are fully treated of.

We notice some omissions. For instance, we see no allusion to the treatment of lepra by diuretics, from which we have seen the best effects derived; but in general the practitioner well acquainted with the appearances of skin diseases will find in the volume all the recent improvements in their treatment.

The formulary added to the work will, no doubt, prove useful to medical men in prescribing, but not in preparing medicines. Under the head *Mist. ferri iodidi* we find the following:—"N. B.—The liq. ferri iodidi is made by macerating in three pints of water ziv . of iron filings, ziiss . of iodine, and zij . of glycerine." The practitioner who tries to make a liq. ferri iodidi in the way indicated, we may as well say will probably fail in the attempt.

A Dictionary of Chemistry and the Allied Branches of the Sciences. By HENRY WATTS, B.A., F.C.S. London: Longman and Co. Part XXI.

THIS number gives the completion of a very able article "*On Light*," by Dr. Roscoe, and carries the work on as far as Lipic Acid.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2105. Charles George Lundborg, Sodertelje, Sweden, "An improved mode of extracting oils from coal or other bituminous substances yielding hydrocarbon oils."—Petition recorded August 26, 1864.

2318. Theodore Anthony Rochussen, Friday Street, Cheapside, London, "Improvements in the construction of furnaces for melting metals in crucibles, and also in the construction of crucibles."—Petition recorded September 21, 1864.

2486. Charles Hastings Collette, Lincoln's Inn Fields, Middlesex, "Improvements in magneto-electric machines." A communication from Theodore Faucheux, Avenue Trudaine, Paris, France.—Petition recorded October 10, 1864.

2553. Thomas Randle, High Street, Hoxton Old Town,

Middlesex, "A new preparation or compound substance for the eradication of corns, bunions, warts, and excrescences of the like nature on the feet or hands."—Petition recorded October 15, 1864.

2641. Edward Henry Taylor, Padeswood, near Mold, in the county of Flint, "Improved apparatus for drawing off or emptying the contents of casks, ships' tanks, and other vessels containing petroleum, paraffin, and other matters or liquids, and also the application of similar apparatus for the supply and stoppage of air."—Petition recorded October 25, 1864.

2645. James Dannatt, borough of Sunderland, in the county of Durham, "An improved composition for preventing the fouling of the bottoms of ships and vessels, and for the preservation of the iron or wood of which the same are constructed."

2653. John Nimmo, Borrowstowness, in the county of Linlithgow, N.B., "Improvements in apparatus for distilling oils or resinous matters."—Petitions recorded October 26, 1864.

Notices to Proceed.

1501. John Macarthy, Alderney Road, Mile End, Middlesex, "Improvements in apparatus or means employed for freezing or cooling fluids or other matters." A communication from Edward Preble Torrey, New York, U.S.A.—Petition recorded June 16, 1864.

1529. Joseph Hamilton Beattie, Dowgate Hill, London, "Improvements in the means of preventing the formation of, and in the removal of, incrustations or deposits from steam-engine boilers." A communication from Joseph Marks, Montreal, Canada.—Petition recorded June 20, 1864.

1533. Wilhelm August Abegg, Westminster Palace Hotel, Victoria Street, Westminster, Middlesex, "Improvements in apparatus for distilling spirituous liquors."—A communication from Carl Falkman, Saint Petersburg, Russia.

1543. Thomas Ogden Dixon, Steeton in Craven, *via* Leeds, Yorkshire, "Improvements in stoppers for bottles, jars, and similar articles, and in means or apparatus for withdrawing such stoppers from bottles, jars, and similar articles."—Petitions recorded June 21, 1864.

1570. Alexander Hett, London, and Frederick William Basset, Camberwell, Surrey, "Improvements in preserving animal and other substances."—Petition recorded June 23, 1864.

1599. Benjamin Franklin Stevens, Trafalgar Square, Middlesex, "Improvements in the application of petroleum, coal oil, and other similar substances to the purposes of heating, lighting, and obtaining motive power, and in the apparatus employed therein."—A communication from Simon Stevens, New York, U.S.A.—Petition recorded June 25, 1864.

1655. William Edward Gedge, of the firm of John Gedge and Son, Wellington Street, Strand, Middlesex, "Improvements in the firework known as Roman candle."—A communication from Henri Frédéric Favre-Convel, Nantes, France.—Petition recorded July 2, 1864.

2137. John Stenhouse, Rodney Street, Pentonville, Middlesex, "Improvements in rendering certain substances less pervious to air and liquids, and also less liable to decay."—Petition recorded August 31, 1864.

2237. Zoheth Sherman, Durfee, Pittsburg, Pennsylvania, U.S.A., but at present residing at Birmingham, Warwickshire, "Improvements in apparatus for generating gas for fuel, and in furnaces for applying gaseous fuel to metallurgical and other operations."—Petition recorded September 13, 1864.

2413. John Johnson, Runcorn, Cheshire, "Improvements in decomposing common salt with sulphuric acid in the manufacture of soda and muriatic acid."—Petition recorded September 30, 1864.

2472. George Haseltine, Southampton Buildings, Chancery Lane, Middlesex, "An improved process for

purifying coal and ores."—A communication from Benjamin Franklyn, Penniman City, County, and State of New York, U.S.A.—Petition recorded October 7, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, November 8.

THE great scientific event of last week was the *soirée* given by General Morin at the Conservatoire des Arts et Metiers, for the benefit of the Associations for the Advancement of Astronomy and Meteorology. It was a most brilliant affair, and the display of machines and instruments of all kinds was magnificent. The exterior and large apartments of the building were illuminated by the electric light. In the large amphitheatre a number of experiments on optics applied to acoustics, and others with the Rhumkorff coil were shown, which Dr. Tyndall and Mr. Ladd have made familiar to the frequenters of the Royal Institution and most scientific gatherings in London. A small concert was given in the little amphitheatre, where an artist performed some music on Marie Antoinette's harpsichord. More than 2000 visitors were present, who departed at a late hour, immensely gratified by what they had seen.

Englishmen have often to laugh at the mistakes which French journals fall into when dealing with English affairs. They are sometimes not much happier when dealing with matters further from home. Just now the scientific journals of Paris are having a laugh at their daily political contemporaries for gravely announcing a week or two ago, among the astronomical events of November, that "the planet Mars, *which is only visible every fifteen years*, will be at its brightest this month, and may be readily distinguished in the evening by its red light." By way of excusing his countrymen, M. Flammarion suggests that the writer of this paragraph was thinking of Saturn's ring, which becomes *invisible* every fifteen years!

As a fact likely to be interesting to some of your readers, I may mention that M. Alcan has recently published a complete treatise on the manufacture of cotton. It is a book which I should think would have great interest for cotton manufacturers. The machinery is very fully described and explained, and this part of the work is illustrated with a large number of beautifully executed engravings. In the first part the author gives a complete account of all kinds of cotton, and, indeed, all textile substances, and whatever has yet been proposed as a substitute for cotton. He also gives a full account of the development of textile industry. The last part contains useful hints on the construction of a factory, and its arrangements, &c., which, although given from a French point of view, may, nevertheless, have some value in the North of England.

A Monsieur Damoiseau has recently called attention to a monstrous (artificial) leech—*Térabdelle*—which he has invented. It seems to have many advantages over the old-fashioned pneumatic cupping apparatus. The author is able to draw, with one glass, 60 grammes of blood per minute, and the blood does not immediately form a clot which plugs the vessels, as with the cupping-glass. Blood-letting is so much out of fashion in England that probably no one will take any notice of this invention, and yet it seems to offer advantages which are deserving of attention.

The French carry out the principles of association to a much greater extent than you do in England. M. About, in *Le Progrès*, has recently tried to persuade the young men of Paris to combine for the purpose of getting good and cheap dinners, and his advice is likely to be taken. In the meantime, I may inform you that there is in Paris, under the name of the National Union of Commerce and Industry, a society composed of a large number of manu-

facturers who, by a small annual subscription, support an analytical laboratory, which is under the direction of M. Poinot, from whom they can have advice and assistance in their respective trades. The same society is about to start a journal which is to be partly of a social character, but is also to contain scientific articles of value. And that is all the news that I can gather this week.

On the Equivalent of Indium.

To the Editor of the CHEMICAL NEWS.

SIR,—From the equivalent of indium given in your last impression (viz., 463.4, O = 100; or 74.14, O = 16), it seems probable that that metal is the mean of a triad consisting of silicon, indium, and tin; or, perhaps, of another triad composed of aluminium, indium, and uranium.

If we regard indium as belonging to the same group as zinc, it will form one of a series of elements having consecutive equivalents, including Cr, Mn, Fe, Co, Ni, Cu, Zn, and In; the equivalent of zinc being the mean of those of iron and indium.

We must, however, wait for further details of the properties of this newly-discovered element, and especially of its atomicity, before it can be safely assigned to any particular group.

It will be seen that the equivalent of indium is next in numerical order to that of zinc, and but slightly below that of arsenic; and we have already observed that "elements having consecutive equivalents frequently either belong to the same group or occupy similar positions in different groups."

I am, &c.

JOHN A. R. NEWLAND, F.C.S.

Laboratory, 19, Great St. Helens, E.C., Nov. 8.

Alteration in the Weight of Copper.

To the Editor of the CHEMICAL NEWS.

SIR,—It is a curious fact that if a certain weight of rough copper be made into forgings the weight of the forgings produced from the copper will be greater than the original weight of the rough copper, which, it would appear, thus increases by hammering. To a stranger this may appear ridiculous, but any practical person who has had anything to do with copper forging can verify the fact. Can you kindly give any explanation of this paradox?

I am, &c.

W. A. B.

October 28.

MISCELLANEOUS.

The Royal Society.—The election of the following officers and council will take place on St. Andrew's day, November 30, 1864. The Fellows whose names are printed in italics were not members of the last Council:—

President—Major-General Edward Sabine, R.A., D.C.L., LL.D.

Treasurer—William Allen Miller, M.D., LL.D.

Secretaries—William Sharpey, M.D., LL.D.; George Gabriel Stokes, Esq., M.A., D.C.L.

Foreign Secretary—Prof. William Hallows Miller, M.A.

Other Members of the Council—Prof. John Couch Adams, M.A.; James Alderson, M.D.; George Busk, Esq., Sec. L.S.; Col. Sir George Everest, C.B.; Hugh Falconer, M.A., M.D.; John Peter Gassiot, Esq.; John Edward Gray, Ph.D.; Thomas Archer Hirst, Ph.D.; Sir Henry Holland, Bart., M.D., D.C.L.; Henry Bence Jones, M.A., M.D.; Sir Roderick Impey Murchison, K.C.B.; William Odling, M.B.; Prof. William Pole, C.E.; Rev. Bartholomew Price, M.A.; Sir John Rennie, Knt.; the Lord Stanley.

Baron Liebig.—The *Moniteur Belge* contains the following extract from the *Journal de Francfort*:—"A friend writes from Munich that the celebrated chemist, Baron Liebig, is about to resign his professorship and laboratories at the University of Munich, with the inten-

tion of settling in London to occupy an important position which has been offered to him *par la grande compagnie du balayage et des vidanges de Londres*," whoever they may be.

Chemical Society.—The next meeting of this Society will be held on Thursday next, at eight o'clock, when the following papers will be read:—Dr. Marcet, "Brine of Salted Meat;" Professor Wanklyn, "Nature of Compound Ethers."

Dye for Feathers.—An important branch of the art of dyeing feathers for the toilet has lately undergone much improvement, through the discovery of aniline colours. Before being dyed, feathers ought always to be well cleaned and blanched, to get rid of the fatty or colouring matters. After properly assorting the feathers, treat them with a tepid solution of 0.062 of soap in 1 kil. of water. Let the feathers steep in this bath until the soap has had its effect; then repeat the operation in another soap bath. Then wash the feathers in plenty of water, bleach them with sulphurous acid obtained by the combustion of sulphur, and wash and dry them. Feathers are dyed black by boiling in an alum and logwood bath, with the addition of sulphate of copper and iron; lilac by archil; carmine, indigo and alum; yellow of various shades, by acetate of lead and chromate of potash, or better still, by arnotto and a solution of potash; green, by a solution of indigo and picric acid; blue, by a solution of indigo and alum, or better by nitrate of iron and yellow prussiate of potash; red, by cochineal or Brazil wood. But the most beautiful shades of red, violet, and blue are obtained with aniline colours, which adhere to feathers with as much brilliancy as to silk or wool. It is only necessary to plunge the cleaned feathers into the bath of aniline colours, and to let them remain until completely dyed. As now made, pure and dry aniline colours, such as red, violet, and blue, merely require to be dissolved in alcohol and then diluted with water, before being poured into the bath. Besides aniline and the colours derived from it, French purple gives very various shades. The dye bath must not be kept too hot, as the feathers would be attacked. After dyeing, the feathers are washed, dried, and curled, the latter operation being performed with a well-polished bone knife.—*Moniteur Scientifique*, vi. 664, 64.

Cotton Seed Oil.—Lipowitz states that the deep brown commercial oil parts with its colouring matter readily by treatment with alkaline solution, yielding from 80 to 85 per cent. of a clear yellow oil, which is almost entirely without smell, and resembles in taste the finest salad and poppy-seed oils. It solidifies at from 3° to 0° C. The crude oil, which may be ranked among the drying oils, has a sp. gr. of .928 at 15° C., the purified oil of .9206. The fatty portion of the crude oil amounting to 15 or 20 per cent., which is readily saponified by alkalies, may be obtained by the action of acids upon the soap in the form of a brownish or greenish butter-like mass, which is well adapted for a waggon or machine grease, since it remains fluid a long time in a warm place, and does not resinify. It may also be used for the preparation of an odourless potash or soda soap.—*N. Jahrb. Ph.* xx. 330.

ANSWERS TO CORRESPONDENTS.

Alpha.—The last edition of Fowne's and Watts' Dictionary.

A. C.—Apply to Messrs. Trübner and Co., Paternoster Row.

J. C., Bath.—The best special work on the subject is in French, by Louis Grandeau.

D. T. O.—1. One and a-half parts of iodine are dissolved in one part of aniline: hydrochloric acid is added to the mixture. The crystals obtained are washed with dilute hydrochloric acid, and purified by several crystallisations. 2. Probably a sulphite.

Pamphlet Received.—De l'Alimentation des Enfants. Mémoire de Mme. Baines.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Synthesis of Butyric and Caproic Acids, by ALFRED R. CATTON, B.A., Fellow of St. John's College, Cambridge, and Fellow of the Cambridge Philosophical Society.*

(Continued from page 207.)

To return now to the deposit produced in the original evaporation in air of the calcium salts.

The whole of these deposits were collected and boiled with a mixture of thirty-five parts of water and one of concentrated nitric acid. After boiling for a quarter of an hour, about one-half of the deposit dissolved; the residue was of a dark brown colour, similar to the brown deposit before mentioned, produced on evaporating the mixture of the potassium salts. This dark brown residue was collected on a filter, washed, and dried. The filtrate, still considerably acid, was evaporated in vacuo, over sulphuric acid.

The residue was treated with a small quantity of absolute alcohol to dissolve out the nitrate of calcium. The remainder, which was perfectly white, was dried at 100° C. 0.526 grm. of the salt gave 0.276 grm. of sulphate of calcium. The salt, therefore, contained 15.3992 per cent. calcium; caproate of calcium contains 14.8148 per cent. calcium.

The foregoing analyses prove conclusively that an acid having the same molecular weight as caproic acid—viz., 116—is produced in the reaction.

This acid having the molecular weight 116, possessed also the general characters of caproic acid. It had a strong sudorific odour.

The calcium salt was soluble in about forty-nine parts of water, and its solution deposited a basic salt $C_{12}H_{11}CaO_4 \cdot Ca_2O_2$ when heated.

The silver salt was precipitated on the addition of nitrate of silver to the calcium salt. It was completely soluble in boiling water.

It remains to show that this acid possesses the same percentage composition as caproic acid, and that its more minute characters agree with those of caproic acid.

To return now to the brown residue insoluble in dilute nitric acid.

On being dried, this residue became white; but on the addition of water a portion of it again became brown, the other part remaining white, and the same thing occurred on again drying and then adding water. The solution was colourless, and on being evaporated again gradually became yellow, and formed a flocculent deposit.

The white portion dissolved completely on the addition of 150 parts of water; while, from a rough determination which I made, the brown portion did not dissolve till 8370 parts of water had been added.

Neither caprylate nor caprate of calcium requires more than 200 parts of cold water for its solution; whilst laurate of calcium requires about 10,000 parts, the calcium salts of all higher acids being as little soluble as laurate of calcium.

From these facts it appears probable that the white portion was a mixture of caprylate and caprate of calcium; and that the brown portion was either laurate of calcium $C_{24}H_{23}CaO_4$, or a mixture with laurate of calcium of the calcium salts of higher acids,—myristic, stearic, &c.

Unfortunately, there was not enough either of the

white or brown portion for a calcium determination, so the two were added together, and an analysis made of the calcium in the mixture. 0.421 grm. gave 0.164 grm. of sulphate of calcium, or 0.0048 Ca. The salt, therefore, contained 11.4014 per cent. Ca. Caprylate of calcium contains 12.2699 per cent. Ca. Caprate of calcium contains 10.4712 per cent. Ca. The quantity of calcium was therefore intermediate between caprylate and caprate of calcium, thus pointing to the presence of caprylic acid, and also of higher acids, capric, lauric acid, &c.

The production of such high acids in the process as capric and lauric acids is rendered additionally probable by the following facts:—When the mixture of the potassium salts of the acids obtained by precipitation with subacetate of lead and decomposition by sulphuretted hydrogen, was evaporated, a brown deposit, before alluded to, was formed. It was insoluble in a large quantity of cold water.

Now, as the neutral potassium salts of all the fatty acids are easily soluble in water, it only appears possible to account for this brown deposit on the supposition that it was an acid potassium salt of one of the higher fatty acids, for it is well known that there is a great tendency to deposit acid potassium salts on evaporating solutions of the neutral potassium salts of those acids nearly insoluble in water. This view is corroborated by the fact that this same brown deposit was formed on adding a few drops of acetic acid to the mixture of the potassium salts after the solution had been considerably concentrated by evaporation.

I now proceed to consider the explanation of these experiments. When I commenced them I was under the impression that it was a fact generally known and admitted by chemists that sodium-alcohol decomposed at a certain temperature not much above 100° C. into ethylene and hydrate of sodium. In order, therefore, to show that sodium-alcohol was at the temperature employed during the reaction decomposed in this manner, I was content with observing the following facts:—

1. That an inflammable gas, not containing vapour of alcohol, and burning with a bright white flame, was evolved during the reaction.
2. That the contents of the retort were of a dark coffee-brown colour, and had the same appearance as when alcohol is heated for a length of time with caustic soda (or potash).

I relied upon the first fact as proving the evolution of ethylene, and on the second as showing the presence of caustic soda in the retort. When I read this paper before the British Association, however, this fact was denied by one chemist.

Being now at a distance from works of reference, I cannot state exactly where I read that sodium-alcohol does decompose in this manner. But Hofmann certainly observed the fact in his researches on the action of cyanate and cyanurate of ethyl on sodium-alcohol.

By the action of cyanate of ethyl on sodium-alcohol Hofmann obtained triethylamine, and he observes that, in many cases, sodium-alcohol affords a convenient means of ethylation, but that its use is limited on account of the low temperature at which it decomposes.

In the action of cyanurate of ethyl on sodium alcohol some of the same products were obtained as in the action of caustic soda on this compound—viz., hydrate of carbetriethylamine and ethylamine, and ethylene was evolved in abundance. The theory of this reaction Hofmann distinctly states to be the decomposition of the sodium-alcohol by heat into ethylene and caustic soda.

I am aware that Wanklyn's experiments show that it

* The experiments described in this paper were communicated to the Chemical Section of the British Association, September 16, 1864.

is not decomposed at $100^{\circ}\text{C}.$; but I conceive that the evolution of an inflammable gas burning like ethylene and the production of caustic soda in the retort are quite sufficient to show that the decomposition did take place at the temperature of the experiment, $236^{\circ}\text{--}238^{\circ}\text{F.}$, $113.3^{\circ}\text{--}114.4^{\circ}\text{C}.$

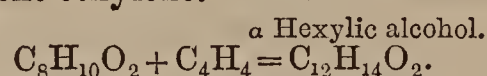
I shall take care to prove conclusively that such is the case in my future experiments.

I observed, however, that the decomposition of the sodium-alcohol took place very slowly at this temperature, which was the principal reason why the reaction had to be continued for seventy hours, and even at the end of this time the greater portion remained undecomposed.

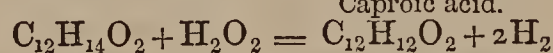
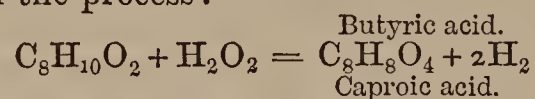
I intend, on repeating these experiments, to operate in sealed tubes, which, by increasing the pressure and therefore the temperature of the boiling point, will greatly facilitate the decomposition of the sodium-alcohol.

Two theories may be advanced to account for the production of butyric and caproic acids in these experiments. It may be supposed that the acetate of sodium takes no part in the reaction; in fact, that its only use in the process is to raise the boiling point to the temperature of decomposition of the sodium-alcohol. On this view the sodium-alcohol decomposes into ethylene and caustic soda; and the ethylene when in the nascent state combines with the alcohol with the production of butylic alcohol. Thus— $\text{C}_4\text{H}_6\text{O}_2 + \text{C}_4\text{H}_4 = \text{C}_8\text{H}_{10}\text{O}_2$.

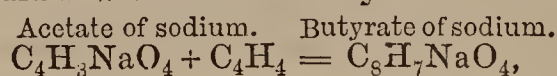
And further, a portion of the butylic alcohol thus produced is converted into α hexylic alcohol by combination with nascent ethylene. Thus—



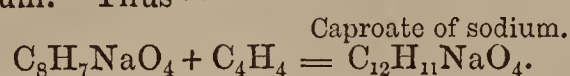
We must suppose that the butylic and hexylic alcohols are converted with evolution of hydrogen into butyrate and caproate of sodium, by the action of the caustic soda produced in the process:—



The other theory which may be advanced is that the butyrate of sodium is produced by the combination of acetate of sodium with nascent ethylene. Thus—



and that the caproate of sodium is produced by the combination of nascent ethylene with a portion of the butyrate of sodium. Thus—



This was the view I took of the reaction in my paper before the British Association.

I believe, however, that the nascent ethylene combines both with the alcohol producing butylic and hexylic alcohols, and with the acetate of sodium producing butyrate and caproate of sodium; but I doubt whether the alcohols are converted into butyrate and caproate by the action of the caustic soda. It is for this reason that I believe the butyrate and caproate of sodium are produced principally, if not entirely, by the combination of nascent ethylene with acetate of sodium.

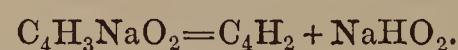
It is to be observed, however, that in order to account for the production of butyrate and caproate of sodium, one of these processes must go on, and even if the combination with acetate of sodium does not take place at all, that with alcohol must; and it is quite as important to have converted ordinary alcohol into butylic and hexylic alcohols as to have converted acetate of sodium into butyrate and caproate of sodium.

Future experiments will decide whether one only (and if so which) or both of the processes referred to go on together.

The method of synthesis given in this paper was suggested by a theory of the molecular constitution of carbon compounds which differs from the views at present adopted by our most eminent chemists. It will probably prove to be a general process applicable to all series of carbon compounds, so that any given term of a homologous series will be converted into any higher term by direct union with nascent ethylene or one of its homologues—*e.g.*, ordinary alcohol into heptylic alcohol by combination with one molecule of nascent amylene produced by the decomposition of amylate of sodium; oxalate of potassium into succinate of potassium by combination with one molecule of nascent ethylene; benzoate of potassium into cuminate of potassium by combination with one molecule of nascent tritylene, &c.

It has been already shown by M. Lippmann that dichloroformic aldehyd (phosgene) is converted into dichloropropionic aldehyd (chloride of lactyl) by direct combination with one molecule of ethylene.

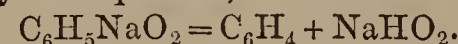
This method of synthesis is capable of great extension by substituting for ethylene and its homologues other hydrocarbons and oxidised compounds when in the nascent state, thus enabling us to obtain from one compound others belonging to different homologous series. These hydrocarbons and oxidised compounds will be produced by different methods in different cases; in many cases, probably, by the decomposition of the compounds obtained by the action of sodium or potassium or the other alcohols, aldehyds, acetones, glycols, &c. For instance, there appears to be no reason why sodium-aldehyd $\text{C}_4\text{H}_3\text{NaO}_2$ should not decompose when heated in a sealed tube into acetylene C_2H_2 and hydrate of sodium.



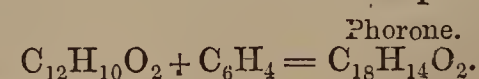
Berthelot has found that by heating aldehyd in a sealed tube for 100 hours a number of polymeric hydrocarbons are produced having the formula $n(\text{C}_4\text{H}_2)$; in this case we may suppose that acetylene was first produced and afterwards converted into the hydro-carbons $n(\text{C}_4\text{H}_2)$ by molecular condensation.

The method of synthesis thus generalised has already been applied, although the theory of the process has not been understood by chemists. We will give two examples:—

Städeler has shown that when sodium is dissolved in anhydrous acetone two higher compounds, pinacone and phorone, are produced. In the first place, sodium-acetone is produced, but it is decomposed by the heat generated by the violent action of sodium on acetone in the manner represented by the equation,



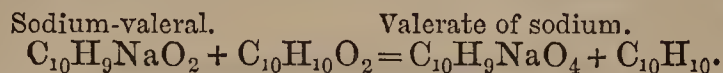
The hydrate of sodium is separated in white flakes. The hydrocarbon C_6H_4 (which is, no doubt, identical with allylene), combines at the instant of formation with acetone with production of the compound $\text{C}_{12}\text{H}_{10}\text{O}_2$. The compound thus produced combines again with C_6H_4 , produced by the decomposition of another portion of sodium-acetone with the formation of phorone—



In the experiment, however, the hydrogen produced by the action of the sodium on acetone is not given off, but when in the nascent state combines with the compound $\text{C}_{12}\text{H}_{10}\text{O}_2$, converting it into anhydrous pinacone— $\text{C}_{12}\text{H}_{12}\text{O}_2$.

In a late number of Erlenmeyer's *Zeitschrift*, M. Borodin has shown that by the action of sodium on valeral two compounds $C_{20}H_{20}O_2$ and $C_{20}H_{22}O_2$ are produced, and also valerate of sodium. The theory of this reaction, however, appears to be different from that of the action of sodium on acetone.

Valerate of sodium appears to be first produced as follows:—



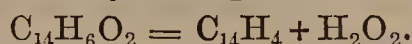
The hydrocarbon $C_{10}H_{10}$ at the instant of formation combines with valeral with the formation of the compound $C_{20}H_{20}O_2$ —



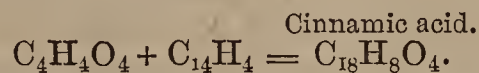
and the latter compound, by the action of nascent hydrogen, is partially converted into the compound $C_{20}H_{22}O_2$, isomeric with capric alcohol.

Bertagnini has shown that by heating chloride of acetyl in a sealed tube with benzylic aldehyde to about $120^\circ C$. for a number of hours, cinnamic acid is produced.

Here the chloride of acetyl, having a strong attraction for water, at length decomposes the aldehyde in the manner represented by the equation—



At the instant of decomposition of the aldehyde chloride of acetyl is converted into acetic acid, and the hydrocarbon $C_{14}H_4$ combines with the acetic acid with the formation of cinnamic acid—

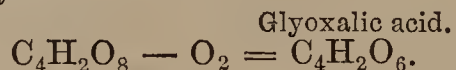


It appears also that the hydrocarbons $C_{2n}H_{2n+2}$ when in the nascent state may combine with some compounds. This at least appears to be the explanation of the reaction by which Frankland and Duppa have obtained several isomers of leucic acid and its homologues by the action of zinc ethyl and zinc methyl on various oxalic ethers.

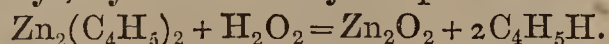
Let us take the case first investigated—viz., the action of zinc ethyl on oxalic ether.

To simplify the explanation we will first suppose the reaction to take place on oxalic acid.

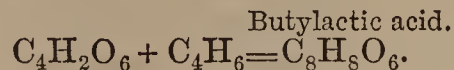
In the first place the oxalic acid is reduced to Debus' glyoxalic acid, and a portion of the zinc ethyl is converted into ethylate of zinc—



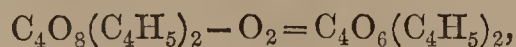
Frankland finds that the addition of water is necessary to complete the reaction. By the action of water on zinc ethyl, hydride of ethyl is produced.



The hydride of ethyl when in the nascent state combines with the glyoxalic acid with the formation of butylactic acid.



We may here observe that Debus has shown that by the action of nascent hydrogen (which is homologous with hydride of ethyl) on glyoxalic acid, it is converted into glycollic acid (which is homologous with butylactic acid). To take now the case of oxalic ether. It is first reduced by the action of the zinc ethyl to ethylglyoxalic ether,

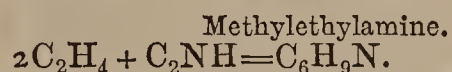


which by combination with nascent hydride of ethyl is converted into ethylbutylactic ether, analogous to ethyl-lactic ether.

Ethylbutylactic acid $C_{12}H_{12}O_6$ is isomeric with leucic acid. A similar explanation applies to the other reactions, as of zinc methyl on oxalate of methyl, &c.

If zinc ethyl were added drop by drop to an aqueous solution of oxalic acid, probably no reduction of the latter would take place; but it would be converted by combination with nascent hydride of ethyl into the acid $C_8H_8O_8$ homologous with glyceric acid $C_6H_6O_8$ and with glyoxylic acid, $C_4H_4O_8$.

If this explanation of the reaction be the true one, the nascent hydrides of methyl, ethyl, &c., produced by the regulated action of water on zinc methyl and zinc ethyl, &c., will be capable of being applied extensively in organic synthesis. Thus, just as by the combination of carbonic anhydride with nascent hydrogen formic acid is produced, so it might be found possible to effect the combination of carbonic anhydride and the nascent hydrides of methyl and ethyl, with the production of acetic and propionic acids. Again, by the combination of nascent C_4H_6 with (glyoxal $C_4H_4O_4$, an isomer of butyric acid homologous with Church's isomer of acetic acid* would, perhaps, be produced; also methylethylamine by the combination of nascent C_2H_4 with hydrocyanic acid, &c.



I shall not pursue these speculations further; enough has been said to show the extensive developments of which the methods of synthesis enunciated in this paper are capable.

For the continuation of the experiments described in this paper, a grant from the British Association has been placed at my disposal.

The experiments were made in the laboratory of the University of Edinburgh, with the kind consent of Professor Playfair.

Grantham, October 17.

Errata.—The reader is requested to make the following corrections in the portion of Mr. Catton's paper in the CHEMICAL NEWS of October 29:—Page 206.—First column, line 24 (from top), *dele* "A part of." Second column, lines 48 and 49, *for* "carbonic acid," *read* "carbon." Page 207.—First column, line 44, *after* "the residue," *insert the words* "which had a strong sudorific odour." Second column, line 13, *for* "gave," *read* "give." Second column, lines 20, 23, 24, 32, *for a read* 4—*i.e.*, *for* " $C_{12}H_{11}CaO_4.Ca_2O_2$," *read* " $C_{12}H_{11}CaO_4.Ca_2O_2$;" and *for* " $C_{12}H_{11}CaO_4$," *read* " $C_{12}H_{11}CaO_4$."

On Chrysen, by JOHN GALLETTY.

THIS body was first discovered by Laurent, and is now pretty well known. It is obtained from various sources by destructive distillation, but is probably best known as got from coal tar. It is well described in the latest edition of Fownes' Chemistry as a "pure yellow crystalline powder, which fuses by heat, and sublimes without much decomposition, &c." I have found it also to be a substance which is abundantly obtained by distilling coal at a low temperature. It likewise shows itself in the distillation of most shales. Towards the end of the distillation of the crude oil it is to be observed in the worm pipes, very often in considerable quantities, exactly as when coal tar is distilled. Its composition as obtained from paraffin oil agrees exactly with the formula $C_{12}H_4$ as usually written. I observe this is doubled in Strecker's German edition of Regnault; but form a compound I have prepared of chrysen with picric

* This isomer of acetic acid would probably be produced by the action of nascent hydrogen on glyoxal.

acid it appears that it ought to be tripled. This compound is easily got by dissolving with heat the chrysen and picric acid in Boghead naphtha, filtering and leaving to cool. It forms groups of long crystalline needles (they may be half an inch long) on the sides of the glass, and of a fine reddish-brown colour. In properties it resembles the analogous compounds got by Fritsche with picric acid and benzol, naphthalin and paranaphthaline. The chrysen compound yielded from 30.70 grains 15.39 chrysen equal to 50.1 per cent. The theory for the formula $C_{36}H_{12} + C_{12}H_3(3NO_4)O_2$ requires 49.9 per cent.

It will be seen that this is the first term of another series of substances in Kekulé's arrangement of organic bodies, which differs from paranaphthaline by C_8H_2 .* The following is a table of these first terms as far as at present known; perhaps the crystallisable benzol is the proper analogue of the higher terms, and from the high melting and distilling point of chrysen, and its leaving charcoal when sublimed, it is not unlikely that a higher hydrocarbon of this class is not to be looked for. The fusing point of chrysen stated in the table is my own determination, and a little higher than its melting point as generally represented.

		Melting points.
Ethylen	. C_4H_4	
Benzol	. $C_{12}H_6$	freezes about 32°F.
Naphthalin	. $C_{20}H_{14}$	„ 175°F.
Paranaphthalin	. $C_{28}H_{18}$	„ 416°F.
Chrysen	. $C_{36}H_{24}$	„ 470°F.

These bodies exhibit a beautiful gradation in their properties. The large crystalline plates of naphthalin when sublimed are not nearly so large in paranaphthalin, and still smaller in chrysen. Paranaphthalin is got in crystals from solution, chrysen only as a fine yellow powder; it may appear crystalline under the microscope. It is the same with regard to solubility; chrysen is very much less soluble than paranaphthalin in any common solvent of hydrocarbons, and the latter much less than naphthalin. The whole of the substances in the table above are likewise similarly acted on by nitric acid, vitriol, chlorine, &c. They all volatilise readily long before they reach their true boiling point, and have likewise the property of being carried much further along the cooling worm pipe than their condensing points would lead us to expect. The volatilising and condensing of this class of bodies is still not well understood.

Ethylen is understood to be obtained more abundantly from coal at a low than at a high temperature. Benzol is known to be got from coal at both temperatures. I have not heard of its being obtained from coal distilled at a black heat, which is said to be a manufacturing process. Naphthalin has only been obtained at high temperatures, so far as we know at present. Paranaphthaline, usually got from coal tar, I believe I have obtained from certain dull-looking cannel coals at a low temperature, but at present cannot present any evidence of this statement. Chrysen is obtained at both temperatures; naphthalin seems to be the only body in the table which a low temperature does not produce, but I hope to be better satisfied on this point before the winter is over.

Laurent's pyren, I am inclined to think, was merely chrysen containing an admixture of paraffin; its composition and properties would agree well with this supposition, and from the difficulty I have sometimes experienced in separating paraffin from chrysen, this is the

conclusion I have arrived at. I may state, however, that I have obtained a solid compound from coal distilled at a low temperature, resembling paraffin in appearance, but not melting till near the boiling point of water. It is possible that pyren may be a higher homologue of this body, but I trust to be able to send you soon a more particular account of this substance, and also of some chrysen compounds.

Mandale, Norway.

On the Synthesis of Butyric and Caproic Acids.*

IN this and a previous number of the CHEMICAL NEWS will be found a paper by Mr. Catton, "On the Synthesis of Butyric and Caproic Acids."† This paper, which was read at the Bath meeting of the British Association, would form a very important addition to organic chemistry if the result at which its author arrives were properly established.

We are bound, however, to state that the experiments detailed in the paper establish nothing beyond disregard on the part of the author of the ordinary methods and requirements of modern chemistry.

Mr. Catton's way of recognising butyric and caproic acids is as follows:—

He obtains a precipitate on adding subacetate of lead to the solution he is testing. This precipitate is suspended in water and decomposed by sulphuretted hydrogen, filtered, and the resulting liquid then heated and subjected to the action of a current of air.

To Mr. Catton's great joy, he finds this solution to be "considerably acid to test paper. The acid or acids thus obtained were, therefore, not acetic acid, but new acids produced in the process."

It will at once occur to our readers that "the process" by which Mr. Catton's solution became "considerably acid" was oxidation of the sulphuretted hydrogen, and that one, if not the only "new acid," was sulphuric acid.

This solution, "considerably acid to test paper," was next neutralised with caustic potash, evaporated, filtered, and mixed with solution of nitrate of silver, in which it determined a precipitate of silver salt. Two determinations of silver in this precipitate gave 52.746 per cent., and "52.30002" per cent. of silver (the latter determination being made on 41 milligrammes of salt).

The quantity of silver contained in pure butyrate of silver is 55.38 per cent.

Mr. Catton's conclusion from all this is "that the acid solutions consisted principally of an acid having the same molecular weight as butyric acid mixed with acids containing a higher percentage of carbon."

It is almost unnecessary to remark that these facts by themselves—in the absence of any proof that the organic acid was volatile or had an acid reaction, and in the absence of an organic analysis, and of all data for determining whether the supposed organic acid was single or a multitude of acids—prove the presence of any one of several thousand possible organic acids quite as much as the presence of butyric acid.

Arrived at this stage of the investigation, the idea seems to strike Mr. Catton that it might be well to attempt a separation of these acids. He prepares a fresh lot of the solution assumed to contain butyric acid, makes a lead salt as before, and decomposes with sulphuretted hydrogen.

After saturating the acid with lime, and taking steps to ensure the absence of excess of lime, he evaporates

* I do not know whether it has been remarked that pyridine, C_5H_5N , the lowest number of its series, differs from chinoline, C_8H_7N , the lowest of its series also, by C_3H_2 .

* Communicated.

† See page 205, *et seq.*

down the solution. During this evaporation, he is surprised to observe that a precipitate (probably consisting, at least in part, of sulphate of lime) makes its appearance. Ultimately he gets a lime salt, and determines the percentage of calcium to be 19.3212. This determination he makes by converting the salt into a carbonate. After making the remark that butyrate of calcium contains 18.6915 per cent. of calcium, he proceeds:—

“The excess in the quantity of carbonate found was, no doubt, due to the presence of a small quantity of carbon, which would be expelled on heating the carbonate with concentrated sulphuric acid, and then converting it into sulphate.” Operating in this manner, he reduced his percentage of calcium to 18.6636.

Now, every chemist knows that an estimation of lime made as carbonate is liable to contain, not excess of carbonic acid, but excess of lime.

In fine, this paper of Mr. Catton's, although read before the British Association, is utterly destitute of any scientific value.

We have deemed it to be necessary to make these remarks partly on account of a circumstance which has recently come to our knowledge. The *Jahresbericht* for 1863 records a research of Mr. Catton's on a kindred subject and of a kindred character.

PHARMACY, TOXICOLOGY, &c.

On Commercial Bromide of Potassium,
by W. T. FEWTRELL.

THE use of bromide of potassium as a remedial agent has of late greatly increased, and it is now administered in very large doses. Recently it has been observed that the use of the remedy has been occasionally followed by symptoms of *iodism*, or the peculiar affections which are sometimes produced by excessive doses of iodine or iodide of potassium. As no such effects have been observed to follow the exhibition of bromide of potassium, the circumstance gave rise to a suspicion that some specimens of the bromide are *adulterated* (the present difference in the price of bromine and iodine justifies this term) with iodide of potassium. I accordingly procured a sample of the salt for examination. It was labelled “Bromide of Potassium (French).” It was a well crystallised salt, the crystals being perhaps rather more opaque than those of the pure bromide. A qualitative examination at once revealed the presence of a considerable proportion of iodine; and quantitative analysis showed that the amount present corresponded to 20 per cent. of iodide of potassium. This adulteration deserves the serious attention of pharmacists and medical men, who will do well to test all samples of bromide they receive. A solution of the salt mixed with a little mucilage of starch should not exhibit any blue colour on the addition of solution of chlorine.

Indestructible Writing.—Lucas proposes for this purpose an ink composed of 20 grains of sugar dissolved in 30 grains of water, to which is added a few drops of concentrated sulphuric acid. Upon heating this mixture the sugar becomes carbonised, and when applied to the paper leaves a coating of carbon which cannot be washed off. This stain is rendered more permanent by the decomposing action of the acid itself upon the paper, and thus made, it resists the action of chemical agents. The paper should, after drying, be passed through a weak alkaline solution to remove excess of acid.—*Breslauer Gewerbebl.* N. Jahrb. Ph. xx. 330.


PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 3.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,
in the Chair.

In concluding our report of this meeting we present an abstract of the paper read by Mr. William Baker, of Sheffield, which appeared to excite a good deal of interest, and led to further discussion. The communication was entitled, “*On the Existence of Nitrogen in Steel*,” by Graham Stuart, F.G.S., F.C.S., and William Baker, F.C.S., Associate of the Royal School of Mines, the authors having proposed to undertake some experiments with the view of procuring data towards the solution of the vexed question “Is nitrogen an essential constituent of steel?” and, if so, for the purpose of showing whether its presence in greater or less quantity could be held to account for the difference in quality of various kinds of steel. With this intention the authors operated upon a number of characteristic samples both of iron and steel, including cast steel, blister steel, and the well-known

mark  Bessemer steel; *spiegeleisen*, a kind of iron now

used to a considerable extent for further carburising steel during the ordinary process of refining; wrought iron of English manufacture, and the same converted into steel by being heated to redness in a current of carbonic oxide gas. The form of apparatus employed has been varied considerably during the progress of the experiments, but the general plan of investigation has remained uniform throughout, and the alterations have only been intended to secure more completely the fulfilment of those conditions which were found to be absolutely indispensable to obtaining a correct result. Those conditions may be briefly stated as consisting either in the total exclusion of nitrogen, in every shape and form, from the apparatus and the gas used, or, as was found sometimes even more satisfactory, in the employment of such a modification of the apparatus as would admit of estimating what quantity of the nitrogen obtained was due to any sources other than the steel under examination. The general method of experimenting was as follows:—Hydrogen purified, and more or less dried, was passed over the steel or other substance under examination, heated to full redness, and was then conducted into a Will's nitrogen apparatus, where the ammonia generated by its passage over the red-hot steel was absorbed in a standard solution of sulphuric acid, and its amount afterwards estimated by volumetric analysis. It was then, of course, easy to deduce by calculation the quantity of nitrogen contained in the steel. In the first experiments, no means were taken specially to exclude or make allowance for the nitrogen that might be present as air, either mixed with the hydrogen in the gasometer or in the tubes of the apparatus before the commencement of the experiment; reliance being placed in the former case upon the hydrogen being prepared with such care as to insure its purity, and in the latter upon the gas being passed through the apparatus for a sufficiently long interval of time to sweep out the air contained in it previous to the experiment being commenced. The above remarks apply particularly to the experiments numbered 1 to 11 inclusive, in which the apparatus used consisted merely of

—1. A solution of potassa; 2. Column of pumice saturated with sulphuric acid; 3. A U drying tube of chloride of calcium; 4. The analysis tube; 5. Will's nitrogen bulbs charged with standard acid. The steel in all the experiments was used either in the form of fine powder (passed through a muslin sieve) filings, grains (the size of ordinary shot); or strips, about 3 to 4 inches long, $\frac{1}{4}$ inch to $\frac{3}{8}$ inch wide, and about $\frac{1}{50}$ th to $\frac{1}{100}$ th inch in thickness. The passage of the gas through the potash-bulbs varied from the rate of 50 to 150 bubbles per minute, and was continued after the heat was withdrawn until the assay tube was quite cold. Table I. exhibits the result of the first eleven experiments just mentioned; by a reference to which it will be noticed that in all these instances, excepting No. 2, nitrogen was obtained, though varying in quantity from .007 to .068 per cent.

TABLE I.

No. of experiment.	Description and state of steel employed.	Quantity of steel.	Duration of experiment.	N. obtained, per cent.
1.	J.B. Blister steel, in grains	50.000 grm.	1 hour.	.068
2.	Ditto	25.000 "	2 "	.000
3.	Ditto	25.000 "	2 "	.0293
6.	Ditto	33.3345 "	2 $\frac{1}{2}$ "	.020
7.	Cast-steel, in strips ..	37.9307 "	1 $\frac{1}{2}$ "	.027
8.	Ditto	18.6485 "	3 $\frac{1}{2}$ "	.018
9.	Bessemer steel, in filings	50.000 "	2 "	.011
11.	Ditto	55.723 "	1 $\frac{1}{2}$ "	.007

These experiments were considered as merely preliminary, and, judging from the experience afterwards obtained, the authors reject altogether Nos. 1, 3, 6, and 7, from the nitrogen obtained being, at all events, in part, derived from other sources than the steel; most probably from some air lingering in the apparatus when the experiment was commenced; and when the comparatively large quantities of nitrogen obtained are taken into account, there can be but little doubt that this source of error vitiated the results in all these instances. Experiment No. 2 demands a special notice. It seems to have given what must now be looked upon as an accurate result; however, as it was only the second experiment of the kind that the authors had made, they did not feel justified in laying any very great stress upon it, although, on referring to their note-book, they could not find any further reason to doubt its accuracy. In experiments Nos. 8, 9, and 11 the amount of nitrogen found had materially decreased. This may probably have arisen from the precautions requisite to insure an accurate result becoming better understood, and especially to extra care being taken in preparing the hydrogen, and in driving out the air from the apparatus more completely before commencing the experiments. On comparing all these experiments generally together, a gradual but unmistakeable decrease in the amount of nitrogen was at once apparent. This appeared strange, and aroused a suspicion that possibly much, if not all of it, might be due to other sources than the metal under examination, and it was evident that more careful experiments were necessary to arrive at a perfectly correct result. It was then determined to try if the nitrogen present in the apparatus could not be entirely removed, so as to insure the hydrogen arriving at the assay tube in a state of absolute freedom from this impurity. The best method of doing this seemed to be to convert it into ammonia, and to absorb it in this state by dilute acid, and the apparatus was accordingly modified thus:—

1. Flask containing potash as before.
2. Tube filled with soda lime at a red heat, and about six inches in length.
3. Dilute sulphuric acid.
4. Assay tube.
5. Will's nitrogen bulbs filled with standard acid.

The distance between the sulphuric acid and the steel was made as short as possible, with the view of reducing to a minimum the quantity of air it would contain, and the

further precaution was taken of passing the gas over the soda-lime for some time before the steel was heated. It will thus be seen that if any nitrogen was present, either in the hydrogen or in the apparatus it would become converted into ammonia by passing over the soda-lime, which passing onwards would be absorbed by the sulphuric acid. There would now remain only the small space above the liquid in the sulphuric acid bottle, and the short and narrow tube between it and the assay-tube in which any air could lodge, to vitiate the results. With this arrangement, experiments 13 to 17 were made. No. 13 and 14 were made upon cast steel in thin strips similar to those previously described, and Nos. 15 and 17 upon *spiegeleisen* crushed to powder in a steel mortar and passed through a fine muslin sieve. It will be noticed by a reference to table No. 2 that considerable quantities of these substances were used, but in only one case was any nitrogen detected. This was in No. 15, upon *spiegeleisen*, but there seems to be some doubt respecting the accuracy of this experiment and it appeared likely that the assay-tube was heated before the air was entirely expelled from it, and as in the subsequent experiments upon the same substance none gave any nitrogen whatever, it is probable that this or some other error must have crept in.

TABLE II.

No. of experiment.	Kind and state of substance employed.	Quantity used.	Duration of experiment.	N. obtained, per cent.
13.	Cast steel in strips .	27.081 grms.	1 hour	.000
14.	Do. do. .	26.706 "	?	.000
15.	Spiegeleisen in fine powder	20.583 "	3 hours	.015
17.	Do. do.	20.000 "	1 hour	.000

In all these experiments the gas issuing from the soda-lime tube was tested for ammonia by placing small pieces of reddened litmus paper in the narrow tube leading from it into the sulphuric acid bottle. They invariably gave indications of its presence, and traces of it could be found even after the hydrogen had been passing through for more than an hour. The assay-tube was never heated until these traces had entirely disappeared. In the next series of experiments that were made, the soda-lime tube was dispensed with, and no means were taken to absorb the nitrogen in the apparatus. The hydrogen was prepared with every possible precaution, however, and was passed direct from the gas-holder into the assay-tube without any intervening apparatus except a wash-bottle filled as full as practicable with a solution of protosulphate of iron, made slightly alkaline with potash. As short an apparatus as possible was used, and the hydrogen passed through it for a long time before heat was applied to the assay-tube, the object being to reduce the amount of air contained in the apparatus to the least possible quantity, and to completely sweep it out, so as to prevent the nitrogen it contained interfering with the result. The protosulphate of iron was intended to absorb any oxygen that might be present, it being frequently found that the steel was slightly oxidised when the experiment was ended. It was replaced for experiments Nos. 51 and 52 by a solution of oxide of lead in potash. This was used to absorb hydrosulphuric acid, a small quantity of which was given off during some of the experiments. This method was found to answer very well in practice, although, of course, open to the objections which have been stated before; very great care was, however, requisite in making the experiments, but when sufficient attention was given, the results might be relied upon. In table No. 3 a detailed account of the experiments made with this arrangement is given; a glance at it will show that in the whole series no amount of nitrogen was obtained that could be considered of any importance, even with the possible chance of the errors previously pointed out. The authors submit that the negative results obtained in these instances are very strong

evidence that nitrogen is not an essential constituent of steel.

TABLE III.

No. of experiment.	Kind and state of steel employed.	Quantity used.	Duration of experiment.	N. obtained, per cent.
19.	Spiegeleisen in fine powder	7.190 grm.	3 hours.	.000
20.	Cast steel in strips . . .	15.536 "	3 1/4 "	.000
21.	Iron in strips	25.713 "	2 "	.0051
23.	Cast steel in filings . . .	14.621 "	6 "	.000
24.	Do. do.	15.077 "	3 "	.000
35.	Do. do.	40.057 "	3 "	.0023
51.	Steel made by heating iron in CO.	8.005 "	2 "	.0015
52.	Spiegeleisen in grains . .	80.000 "	4 "	.000

In the succeeding experiments an important alteration was made in the apparatus, which requires to be shortly described. Two tubes, one containing the steel to be operated upon mixed with soda-lime, and the other containing soda lime only, were placed side by side in the same furnace, and heated to the same temperature, whilst the hydrogen was passed from the same gas-holder through both, the current being so regulated that an equal quantity passed through each tube in a given time. Previously to its entering the tubes the hydrogen was washed by passing successively through solution of potassa and dilute sulphuric acid, and in some cases was partially dried by passing through concentrated sulphuric acid immediately before its entrance into the steel and soda-lime tubes. The first of these was made upon cast steel filings, 6.355 grm. of which were taken and intimately mixed with 6.3 grm. of soda-lime, the same weight of soda-lime alone being placed in the second tube. Both were heated to full redness for two and a-half hours. No nitrogen was obtained. The whole of the series were made in a precisely similar manner, Nos. 25, 30, and 36 upon cast steel in filings, and Nos. 32, 33, 34, and 37 upon JB. blister steel, and iron of the same brand. A reference to the following table will show the results obtained:—

TABLE IV.

No. of Experiment.	Quantity of steel employed.	Kind and state of steel employed.	Quantity of soda-lime mixed with the steel.	Duration of experiment.	N. obtained per cent.
25.	6.355	Cast steel in filings. . . .	6.3	2 1/2 hours	.000
30.	5.000	Do. do.	5.0	6 1/2 "	.000
32.	5.091	JB. Blister steel in filings	5.0	4 1/2 "	.000
33.	10.117	Iron do.	5.0	3 "	.000
34.	9.980	Blister steel.	5.3	2 "	.010
36.	21.040	Cast steel in filings. . . .	15.0	2 "	.0009
37.	19.456	JB. Blister steel in filings	6.7	1 "	.0040

It was invariably found that the greater part of the nitrogen, in those cases where any was obtained, was given off in the early part of the operation, and that towards the end no indication could be found. It appeared very probable from this circumstance that in those instances the nitrogen was supplied by the air in the apparatus. Having given a full description of the methods of experimenting, the authors next direct attention to the different kinds of steel and iron employed, and the quantity of nitrogen obtained from each. Excluding, for the reasons previously given, the first five experiments, there are four made upon JB. blister steel, and iron. Of these, two, Nos. 32 and 33, gave absolutely no nitrogen; whilst the others, Nos. 34 and 37, gave only .004 and .010 per cent., quantities which, in their opinion, were due to the sources of error before mentioned. Taking the average, .0036 per cent. is obtained, an amount which is too small to be considered of any moment. These experiments were all made upon the same sample in the state of filings. Next follow ten experiments upon cast steel. These were made partly on

cast steel in the form of strips and partly as filings. In these a remarkable unanimity is observable in the results, for out of the ten eight gave no indications of nitrogen whatever, and the other two only .018 and .0023 per cent., the average of the whole being .002 per cent., an amount which may be considered as quite inappreciable in influencing the quality of steel. Then come two experiments on Bessemer steel; both these show nitrogen—one to the amount of .007 per cent., and the other .011 per cent. In both these cases large quantities (50 to 55 grms.) were used, and it may be possible that this peculiar kind of steel contains some small quantity of nitrogen; though, even in this case, it would not affect its quality, being most likely an accidental constituent, formed during the process of manufacture, from the stream of air driven through the molten iron forming some compound in it analogous to that which nitrogen forms with titanium, and which is so often found in crude pig-irons. Then follow four experiments upon spiegeleisen, which show, with one exception, a total absence of nitrogen. One of these must be particularly alluded to, viz., No. 52, in which 80 grm. were submitted to experiment for four hours. At the end of this time it was found that no nitrogen whatever had been eliminated. The authors look upon this as being one of the best and most conclusive experiments they have made, and its evidence is very strong in favour of the conclusion that nitrogen is not present essentially in steel. The two experiments which remain to be mentioned were made upon iron of English manufacture, of very soft quality, and the same converted into steel by heating to full redness in a current of carbonic oxide. In both cases the results were so small as to indicate mere traces of no importance. After reviewing the whole of the experimental results which have been described, the authors adopt the conclusion that nitrogen does not exist either in steel or in iron as an essential constituent, and cannot, therefore, be made use of to explain the different commercial qualities of those substances. Taking the average of the whole series of experiments, the proportion of nitrogen amounts only to .0033 per cent., a result which the authors consider to be of no practical value. The adhesion of air to the surface of the steel would be sufficient to explain the amounts which in some instances were obtained, and in experiments carried to such a nicety, this source of error must not be overlooked, and, taken in addition to that arising from the air remaining in the apparatus, small as its amount may have been, would be, nevertheless, quite sufficient to account fully for all the nitrogen obtained. It was not to be expected that in a long series of experiments every one should be equally successful, but they have published the results, good and bad, as they occurred, rejecting only such as contained a manifest and palpable error; and, in summing up the whole of the evidence, the authors give it as their opinion that nitrogen is not an essential constituent of steel or iron, that it very rarely exists in them even as an accidental constituent, and that it has nothing whatever to do with the respective qualities of different samples of those substances.

The PRESIDENT, in inviting discussion upon the subject of Mr. Baker's communication, referred briefly to the difficult nature of the investigation, and the necessity for using every precaution in the conduct of such experiments.

Mr. PERKIN asked the lecturer whether he had assured himself that hydrogen was really capable of abstracting nitrogen from iron or steel; for even supposing the metals contained this element as an essential ingredient, he doubted whether the affinities of hydrogen and nitrogen were such as to permit of the formation of ammonia at a high temperature.

Professor WANKLYN mentioned the result of some experiments performed by Mr. Dittmar, of Edinburgh, upon MM. Will and Varrentrap's method of estimating nitrogen. According to his experience, it was shown that ammonia

was resolved into its constituent gases by the action of a degree of temperature not much higher than that usually employed in the soda-lime process.

Dr. MILLER said there was no doubt regarding the possibility of decomposing ammonia by heat; this happened especially when a current of the gas was passed over red-hot iron filings.

Professor CHURCH alluded to an observation of M. Wöhler, who found that the nitride of boron might be heated for any length of time in a current of pure dry hydrogen without suffering decomposition; but if the gas be passed conjointly with the vapour of water ammonia was at once formed.

Mr. BAKER replied by asserting his belief that steel was permeable by gases at a high temperature, and that if the specimens of metal, whether in filings or rolled strips, had contained nitrogen, such constituent would have been expelled in the form of ammonia. His views partly received support from the well-known fact that it was possible to convert iron into true steel by heating in a current of carbonic oxide, carburetted hydrogen, or cyanogen gas. He would remind the Society of the circumstance that his experiments were merely in repetition of those of M. Fremy, and that they were negative in their character. He had himself endeavoured to produce a nitride of iron for the purpose of investigating its properties, but hitherto without result. The onus lay with those who stated that nitrogen was contained in steel to prove that such a combination was really decomposed by hydrogen. For himself, he believed that the nitrogen had been derived from other sources extraneous to the metal operated upon.

The PRESIDENT said there could be no doubt that a kind of cementation went on at a high temperature, and that the steel was really permeable to gases. But, supposing even the nitrogen to be removed, he doubted whether it would take the form of ammonia. He had himself remarked the facility with which ammonia was decomposed by heat when attempting to employ iron tubes in organic analysis; but owing to a loss of nitrogen, he had been compelled to resort again to the use of the ordinary glass tubes.

LECTURES ON CHEMICAL PHILOSOPHY.—VI.

Delivered at the College of France, by M. A. WURTZ.

The Theory of Types.

(Continued from page 236.)

Williamson has shown that the views before mentioned may be extended to acids, to salts, to compound ethers, &c. Benzoic acid, for example, may be regarded as water modified by substitution. We can form it, in fact, in the following way:—



Chloride of benzoyle. Benzoic acid.

Benzoate of potassium, then, is nothing more than the acid in which K is substituted for H. In benzoate of silver, Ag is substituted for H.

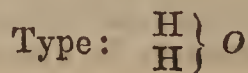
If we treat benzoate of silver by iodide of ethyl, $\text{C}_2\text{H}_5\text{I}$, we form a benzoic ether—



the formula of which is similar to that of the ether,

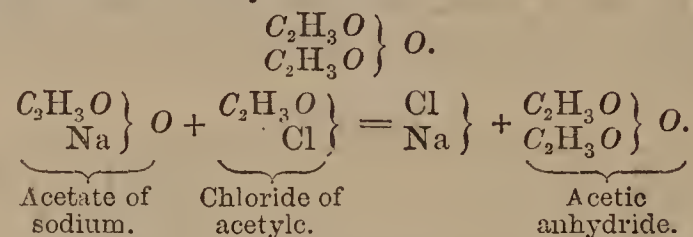


We may here collect together, in the following table, the whole of these typical analogies founded upon experiment:—

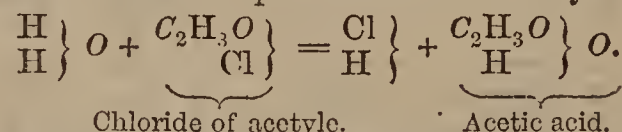


Hydrates.	Oxides.	Salts.
$\begin{array}{c} \text{K} \\ \text{H} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{K} \\ \text{K} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{NO}_2 \\ \text{K} \end{array} \Bigg\} \text{O}$
Hydrate of potassium.	Oxide of potassium.	Nitrate of potassium.
$\begin{array}{c} \text{Na} \\ \text{H} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{Ag} \\ \text{Ag} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{CO} \\ \text{K} \end{array} \Bigg\} \text{O}$
Hydrate of sodium.	Oxide of silver.	Carbonate of potassium.
$\begin{array}{c} \text{CH}_3 \\ \text{H} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{CH}_3 \\ \text{CH}_3 \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{C}_2\text{H}_3\text{O} \\ \text{Na} \end{array} \Bigg\} \text{O}$
Hydrate of methyl.	Oxide of methyl.	Acetate of sodium.
$\begin{array}{c} \text{C}_2\text{H}_5 \\ \text{H} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{C}_2\text{H}_5 \\ \text{C}_2\text{H}_5 \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{NO}_2 \\ \text{C}_2\text{H}_5 \end{array} \Bigg\} \text{O}$
Hydrate of ethyl.	Oxide of ethyl and methyl.	Compound Ethers.
$\begin{array}{c} \text{NO}_2 \\ \text{H} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{C}_2\text{H}_5 \\ \text{C}_2\text{H}_5 \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{C}_2\text{H}_3\text{O} \\ \text{C}_2\text{H}_5 \end{array} \Bigg\} \text{O}$
Nitric acid.	Oxide of ethyl.	Acetate of ethyl.
$\begin{array}{c} \text{C}_2\text{H}_3\text{O} \\ \text{H} \end{array} \Bigg\} \text{O}$	$\begin{array}{c} \text{C}_2\text{H}_5 \\ \text{C}_5\text{H}_{11} \end{array} \Bigg\} \text{O}$	
Acetic acid.	Oxide of ethyl and amyl.	

Gerhardt generalised this opinion, and brought new proofs in support of it. He had before asserted that anhydrous monobasic acids could not exist, seeing that the molecule of normal acids did not contain the elements necessary to form a molecule of water, which would have to be separated. He had not foreseen that these acids might be formed by the union of two molecules of the hydrated acid, a molecule of water being eliminated. A brilliant experiment, however, taught him that it must be so. By treating chloride of acetylene with acetate of sodium, he obtained acetic anhydride—



We know, further, that hydrated acetic acid may be formed by the action of water upon chloride of acetylene.



These reactions show that hydrated acetic acid and acetic anhydride are connected with water by a direct relationship.

Besides the water type, Gerhardt created the *hydrogen* type, under which he classed most of the metals, the organic radicals, aldehydes, acetones, &c.

Elements.	Radicals.	Aldehydes, acetones.
$\begin{array}{c} \text{Cl} \\ \text{Cl} \end{array} \Bigg\}$	$\begin{array}{c} \text{Cy} \\ \text{Cy} \end{array} \Bigg\}$	$\begin{array}{c} \text{C}_2\text{H}_3\text{O} \\ \text{H} \end{array} \Bigg\}$
Chlorine.	Cyanogen.	Hydride of acetylene (aldehyde).
$\begin{array}{c} \text{Br} \\ \text{Br} \end{array} \Bigg\}$	$\begin{array}{c} \text{CH}_3 \\ \text{CH}_3 \end{array} \Bigg\}$	$\begin{array}{c} \text{C}_2\text{H}_3\text{O} \\ \text{C}_2\text{H}_3 \end{array} \Bigg\}$
Bromine.	Methyl.	Methylide of acetylene (acetone).
$\begin{array}{c} \text{K} \\ \text{K} \end{array} \Bigg\}$	$\begin{array}{c} \text{CH}_3 \\ \text{H} \end{array} \Bigg\}$	$\begin{array}{c} \text{C}_7\text{H}_5\text{O} \\ \text{H} \end{array} \Bigg\}$
Potassium.	Hydride of methyl.	Hydride of benzoyle.
$\begin{array}{c} \text{Ag} \\ \text{Ag} \end{array} \Bigg\}$	$\begin{array}{c} \text{C}_2\text{H}_5 \\ \text{C}_2\text{H}_5 \end{array} \Bigg\}$	$\begin{array}{c} \text{C}_7\text{H}_5\text{O} \\ \text{C}_6\text{H}_5 \end{array} \Bigg\}$
Silver.	Ethyl.	Phenylide of benzoyle.

Under the hydrochloric acid type,

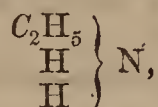


which chemists to-day confound with the hydrogen type,

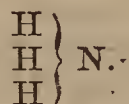


Gerhardt classed the chlorides, bromides, iodides, &c., both organic and mineral. It is needless to insist on the analogy of all these compounds.

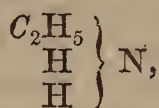
Passing to the *ammonia type*, we may remark that Gerhardt considerably extended it. Before him, the bodies connected with this type were limited to the compound ammonias and the alkaloids in general; ethylamine, for example, was represented as



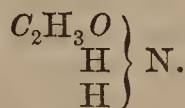
ammonia being



Gerhardt brought the amides under the same type. According to him these only differ from amines by the oxygenated nature of the radical. Ethylamine is



and acetamide is

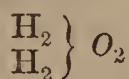


The first of these bodies is a powerful base, the second is a neutral body, which proves that the properties of a body do not depend upon molecular arrangement only, but, beyond this, are a natural function of the elementary atoms. The influence of oxygen upon the properties of bodies which contain it are in this case clearly shown. Ethylated ammonia, which does not contain oxygen, is strongly basic; acetylated ammonia, in which the negative oxygen takes the place of H_2 , is neutral. Gerhardt has since described acid ammonias. According as discoveries followed one another, and the facts were elucidated, this theory has been developed and extended. Before we end this historical *exposé*, we have yet to mention one important point.

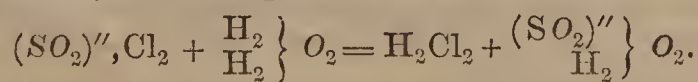
Conceiving that it is impossible to bring under the simple type,



the molecule of polybasic acids, Williamson thought that it would be convenient to adopt types resulting from the condensation of several molecules of water. If we take chloride of sulphuryle (SO_2)" Cl_2 ,"* we find that two molecules of water,



are necessary to decompose it. We shall then have—



Chloride of Sulphuryle.

Sulphuric Acid.

We see by this that sulphuric acid is derived from two molecules of water—that is to say, it belongs to the type of doubly condensed water. This acid is diatomic, because its radical, SO_2 , is substituted for H_2 , or, in other words, possesses a substitution value equal to H_2 .

This idea is the origin of the theory of condensed types, of which we shall speak in a subsequent lecture.

* By the signs ', ', ', ', ', the author as usual indicates monatomicity, diatomicity, triatomicity, &c.

ACADEMY OF SCIENCES.

November 7.

SOME very interesting and important memoirs, which do not come quite within our province, were read at this meeting of the Academy, and of which we need only mention the titles. One of these was by M. Tresca "*On the flow of Solid Bodies Submitted to Strong Pressure.*" The results of numerous experiments showed the author that, without undergoing any change of state, solid bodies flowed from an orifice in exactly the same way as liquids when sufficient pressure was applied to them. He described the apparatus employed, and the materials experimented with, which were the soft metals and ceramic pastes. The results it was said went to prove the unity of the constitution of all matter, showing that masses of the most solid metals are formed of separate and mobile molecules. Another important communication was a description by M. Maissoneuve of a "*New Instrument for Crushing Stones in the Bladder and Extracting the Fragments.*" The author calls his instrument the *lithexère*, or stone extractor; it will no doubt attract the attention of English surgeons.

Among the papers specially within our province we may notice one by M. Weil, "*On New Processes for Covering Metals with Firmly Adherent and Bright Layers of Other Metals.*" The method consists in dipping the metal to be coated in a saline solution of the metal to be deposited rendered distinctly alkaline with potash or soda, and mixed with some organic matter, such as tartaric acid or glycerine. At the same time, it is necessary in some cases to set up a weak voltaic current by keeping a piece of zinc or lead in contact with the metal. In this way the author obtains a firm layer of copper on iron and steel, and procures various and beautiful effects according to the thickness of the copper deposited. Silver, nickel, and other metals can be applied in the same way. The process, it will be seen, is susceptible of numerous applications. A curious fact mentioned is that a clean surface of copper may be coated with zinc by placing the two metals in contact in a solution of caustic soda or potash. In the cold the deposit of zinc takes place slowly, but at 100° it is effected rapidly.

M. Lamy contributed a paper "*On Thallic Alcohols,*" which we shall translate at length. At present we may remind our readers that M. Lamy has already described a compound of thallium and ethylic alcohol, a very dense liquid of great refractive power. In the hope of obtaining a still denser and more refractive body, he sought for a compound of *thallium and amylic alcohol*; this liquid, however turned out to be lighter than the ethylic compound. He then formed *methyl-thallic alcohol*; this is a solid body at ordinary temperatures. The general properties of these compounds, and the methods by which they were prepared, will be described at length in an early number.

M. Le Guen presented a note "*On Tungsten Steel.*" The author's experiments go to show that the addition of tungsten up to $2\frac{1}{2}$ per cent. greatly increases the tenacity of the steel. The effect, however, is rather less when the iron is cemented with wood charcoal than when coke is used.

In a note "*On the Production of Formamide by means of Formiates and Oxalates,*" M. Lorin shows that formamide may be obtained by the distillation of chloride of ammonium and a formiate, the sodic formiate more particularly; and further, that the same body is produced in the careful distillation of acid or neutral oxalate of ammonia. The formamide will be found among the liquids which pass above 130°C .

Among the papers which may be of interest to our medical readers are a description, by M. Guyon, of a parasitic worm, which makes itself a home for a time under the conjunctiva of negroes, but which, according to the author, is a sort of bird of passage, moving about according to its necessities. The paper will be of interest to surgeons and

naturalists. M. Pouchet announced his "*Discovery of Bacteria and Vibrios in Bronchial Mucus, and Discharges from the Nose and Ear.*" Lastly, M. Decaisne presented a note "*On the Effects of Tobacco-smoking on Children,*" ascribing to that indulgence the chloro-anæmic condition he constantly remarks in French boys.

NOTICES OF BOOKS.

Annalen der Chemie und Pharmacie. October, 1864.

WE have in this journal several papers which have already appeared in the CHEMICAL NEWS, including Marignac's "*Researches on the Silico-tungstic Acids,*" Pisani's "*Analysis of Pollux,*" and Mr. Bassett's paper "*On Quadribasic Carbonate of Ethyl,*" as well as papers by Wurtz, Berthelot, and others from the *Comptes Rendus*. Of the original papers, the most important is by Heintz "*On Ethyl-diglycolamidic Acid, and some Compounds of Ethyl-glycocol.*" We must refer readers interested in these bodies to the original paper. Another original contribution is by Braun, "*On the so-called Xanthocobalt Compounds.*" The author differs from Gibbs and Genth as to the constitution of the ammoniacal compounds of cobalt to which they gave the above name, and gives analyses and reasons in support of his own views. Dr. Wickelhaus has a communication in which he shows that the acid obtained by the action of sodium amalgam on *aconitic acid* is identical with the acid obtained by Mr. Simpson from the cyanide of allyl, and which Kekulé has named *carballic acid*. The formula of this acid is $\text{C}_6\text{H}_8\text{O}_6$. It is soluble in water, alcohol, and ether: the salts could not be obtained crystallised. The reaction with salts of peroxide of iron is peculiar. At first only a cloudiness appears, but on long standing, or on boiling, a bulky precipitate forms, which analysis seemed to prove a mixture of a bibasic and tribasic salt. Submitted to a high temperature, the acid at first sublimed, but about 200° it lost water, and left in the retort a crystalline residue, which again attracted water. We have also in this number the continuation of a series of papers giving an account of original researches made in the laboratory at Marburg. The first is "*On the Action of Nascent Hydrogen on Benzoic Acid,*" by Dr. Herrmann. On distilling an excess of benzoic acid in water with sodium amalgam, a distillate is obtained, which smells of bitter almond oil, and contains an oil which partly settles at the bottom and partly remains suspended in small drops. By extracting the alkaline residue with ether, a dense aromatic oil is separated, which in a short time becomes a crystalline mass. By treating the residue exhausted by ether with hydrochloric acid a yellowish offensive oily acid is separated, which can be isolated with ether. The smell of the distillate was, of course, due to the presence of bitter almond oil; the oily drops separated from it on analysis gave results which corresponded with the formula of hydrated oxide of tolyl, $\text{C}_{14}\text{H}_8\text{O}_2$. The crystalline mass extracted from the alkaline residue by ether gave results which accord with the formula $\text{C}_{14}\text{H}_7\text{O}_2$, or $\text{C}_{28}\text{H}_{14}\text{O}_4$. On heating this body with concentrated sulphuric acid it changed into a crystalline mass, which, on dry distillation, was completely converted into bitter almond oil. On distillation in a stream of carbonic acid it gave a crystalline sublimate, which may be benzoic acid. The body appears to be isomeric with *hydrobenzoin*, which Zinin obtained by the action of hydrogen on benzoic aldehyd. As it changes to bitter almond oil on dry distillation, we may suppose it a compound of benzoic aldehyd and an aldehyd two atoms richer in hydrogen, since these two atoms of hydrogen are easily removed by the oxygen of the air.

The oil obtained on decomposing the exhausted alkaline solution with hydrochloric acid is an acid having the formula $\text{C}_{14}\text{H}_9\text{O}_3\text{HO}$, the characters of which are not yet

clearly made out. Reviewing the whole of the phenomena, the author says that by the action of hydrogen on benzoic acid we must believe that the greater part of the acid is at first, by the loss of 2 atoms of oxygen, changed into aldehyd, and then, by taking up 2 atoms of hydrogen, becomes the alcohol, while a small portion of the acid takes up 4 atoms of hydrogen directly without any change in the oxygen contained. The next papers are by Oefele, "*On a New Class of Organic Sulphur Compounds,*" which has already been communicated to English chemists, and on "*Diethylsulphan,*" $\text{C}_4\text{H}_5\text{S}\text{C}_4\text{H}_5$ $[\text{S}_2\text{O}_4]$, or sulphuric acid, in which the two extra-radical oxygen atoms are replaced by two atoms of ethyl. It is a crystalline body soluble in alcohol and water.

We must postpone a notice of other papers in the *Annalen* until next week.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2156. Jacques Fuliraud Pascal Hugouneuf, town of Lodève, Département de l'Herault, France, "An improved method of obtaining indigo from textile materials, either yarns or fabrics, previously dyed by the blue soaking process."—Petition recorded September 2, 1864.

2354. George Printy Wheeler, Abinghall, Gloucestershire and John Fox Gloyn, Manchester, Lancashire, "Improvements in the preparation and application of certain materials for the purpose of cleaning or polishing the surfaces of metals, and also applicable to other purposes."—Petition recorded September 26, 1864.

2522. Edouard Moride, Nantes (Loire Inférieure), and Boulevard St. Martin, Paris, France, "Improvements in the treatment of sea-wrack grass, for the extraction of the carbon and the salts contained therein."

2526. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of prussiates of ammonia, and in the application of prussiates of ammonia to dyeing, printing, and photography."—A communication from Arthur Baudesson and Paul Houzeau, Rheims, France.—Petitions recorded October 13, 1864.

2552. William Clark, Chancery Lane, Middlesex, "Improvements in the preparation of artificial wax." A communication from Jules Montier, Lambert Dietzenbacher, and Abraham Worms, Boulevard Saint Martin, Paris.—Petition recorded October 15, 1864.

2560. John Cassell, La Belle Sauvage Yard, London, "Improvements in apparatus for the carburization of gas and atmospheric air." A communication from Jean Best, Paris, France.—Petition recorded October 17, 1864.

2581. William Taylor, Shiffnall, Henry Harrison Hollinswood, and George Brown, Hollinswood, aforesaid, all in the county of Salop, "Certain improvements in the manufacture of iron."—Petition recorded October 19, 1864.

2598. William Littell Tizard, Birmingham, Warwickshire, "Improvements in brewing and distilling, and in apparatus employed therein, parts of which are applicable to the separation of liquids from solids."—Petition recorded October 20, 1864.

2628. Richard Hookham, Regent's Park, Middlesex, "Improved powder magazines and receptacles for storing or keeping gunpowder or other explosive materials, and improved vessels and vehicles for transporting explosive materials from place to place."

2634. William Clark, Chancery Lane, Middlesex, "Improvements in apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general." A communication from Eugène Alphonse Cotellet, Boulevard Saint Martin, Paris.—Petitions recorded October 24, 1864.

2639. Richard Archibald Brooman, Fleet Street, London, "Improvements in blast and other furnaces." A communication from Auguste De Bergne, Madrid, Spain.—Petition recorded October 25, 1864.

2650. Bonnet Frederick Brunel, Brussels, Belgium, "Improvements in treating titanite iron sands, and in apparatus employed therein."

2654. Richard Hart and John Fraser Calder, Dundee, Forfarshire, N.B., "Improvements in preparing jute."

2656. Peter Armand Le Comte De Fontaine-Moreau, Rue de la Fidélité, Paris, France, and South Street, Finsbury, London, "An improved composition for uniting iron with wood, and leather with leather, for waterproofing textile fabrics, paper, and cordage, for moulding and for various other purposes." A communication from Henry Lemaistre and Company, Brussels, Belgium.—Petitions recorded October 26, 1864.

Notices to Proceed.

1624. Charles Frielinghaus, King Street, Cheapside, "Improvements in the manufacture of starch and yeast, and the machinery employed therein."—A communication from Ignatz Ben, Uerdingen, Prussia.—Petition recorded June 29, 1864.

1638. Frederick Ludewig Hahn Danchell, Red Lion Square, Middlesex, "Certain improvements in apparatus by means of which air, gas, or vapour is to be removed from tubes, pipes, tunnels, pans, retorts, or other vessels."—Petition recorded July 1, 1864.

1663. George Holworthy Palmer, Queen's Crescent, Haverstock Hill, Middlesex, "Improvements in apparatus for heating and evaporating liquids and fluids."

1668. William Lloyd, Dartmouth Street, Westminster, "Improvements in the manufacture of hydro-carbon gas, and in apparatus employed therein."—A communication from William Henderson, Valparaiso, South America.—Petitions recorded July 5, 1864.

1766. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of fluoride of silicon."—A communication from Cyprien Marie Tessie du Motay and Edouard Karcher, Saarbrück, Rhenish Prussia.—Petition recorded July 14, 1864.

2073. James Allan, Dundee, in the county of Forfar, N.B., "An improved adhesive mixture."—Petition recorded August 22, 1864.

2097. Harold Potter, Manchester, "Improvements in bleaching fibrous substances."—Petition recorded August 25, 1864.

2230. Harold Potter, Manchester, "Improvements in bleaching fibrous substances."—Petition recorded September 13, 1864.

2326. Harold Potter, Manchester, "Improvements in bleaching fibrous substances."—Petition recorded September 22, 1864.

2420. Edward Loysel, Park Place, Middlesex, "Improved apparatus for obtaining extracts from tea, coffee, and other vegetable substances."—Petition recorded October 1, 1864.

over, he added, wicked people asserted that some men obtained their Doctor's cap who had never bled a patient, or even put on a bandage; that was very wrong. *Il faut changer tout cela!* He was grieved also sometimes to hear it said that doctors beyond the Rhine were more learned, and doctors on the other side of the Channel more practical, than their Professional brethren in France. "Gentlemen," cried his Excellency, "beat the Germans and the English for me!"

M. Tardieu, in his address, mentioned some facts which do not look well for the Parisian medical student. It seems that 2677 presented themselves for examination last year. Out of the number who passed, only one-third obtained a second class, and only 13 out of 1400 obtained a first-class certificate. That, said M. Tardieu, cannot be the normal state of the Faculty of Paris. Bestir yourselves, young gentlemen! Work; study; an ignorant medical practitioner is a public scourge; an ignorant practitioner is a dishonest man! M. Tardieu is evidently of the same opinion as Calonne, Minister of Finance under Louis XVI. Calonne, it is said, died of a pleurisy and "an ignorant practitioner;" and when he was too far gone to be able to speak, he made signs for a pencil and paper, and wrote to his medical attendant as follows:—"You have murdered me! and if you are an honest man you will never practise medicine any more." I wonder whether Cavour wrote anything like that to his doctors!

Writing on education, I may mention that the scientific journals notice as an event the opening of some evening schools at Mulhouse. They seem to be a combination of your schools of design and an ordinary evening school. Besides reading, writing, common arithmetic, and book-keeping, instruction is given in German and English and design. The classes are held in different factories after the day's work is over, and it seems that they are exceedingly well attended. A public lending library has also been lately opened in the same city. These things are new here, and much good is expected of them.

I may return to the *soirée* at the Conservatoire mentioned last week, in order to notice some of the objects of interest exhibited. Among these was the apparatus used by Lavoisier in effecting the synthesis of water. This has been presented to the Conservatoire by the Academy of Sciences, who kept it in their cellars out of sight. The present proprietors, however, have had the apparatus cleaned up and made to look as good as new. Is Cavendish's eudiometer still in existence, and where is it to be seen? M. Tresca thinks it a good idea to make a collection of such objects, and I agree with him. The simple apparatus of some of the leading discoverers would look strange beside the magnificent display of apparatus which the public professors have at their disposal—paid for, however, out of the public purse. George Stephenson's "Rocket" is at South Kensington; why should they not have Cavendish's eudiometer, if they can get it, and Davy's battery, if the Royal Institution will part with it? How interesting, too, would be a sight of Wollaston's small and simple stock of apparatus.

As you are likely to be short of food for cattle this winter, I may mention that they are feeding pigs here on rice with great success. Porkers, it seems, gain 25 kilogrammes in weight for every 100 kilogrammes of rice consumed. They are allowed to eat the rice as we are bread at the *restaurants—à discretion*. I did not think the discretion of a pig could be trusted in the matter of food.

The sewage question begins to be agitated here, and there is a loud outcry on the part of the engineers against contaminating the Seine like the Thames. To distribute the sewage over the country is the remedy proposed, as with you; but since Paris has yet to be drained, the country must wait.

Some people here have taken it into their heads that England is in a great hurry to adopt the metrical system

CORRESPONDENCE.

Continental Science.

PARIS, November 16.

THE School of Medicine was opened for the session on the 3rd, in the presence of M. Duruy, the Minister of Public Instruction. M. Tardieu, the dean, delivered what you would call the introductory lecture, which consisted of the usual matter—a *resumé* of the discoveries of the past year, praises and regrets for the dead, compliments for the living who retire from the Faculty, and plenty of good advice to the students. M. Duruy added some of the latter on his own account. He was sorry to hear that the students did not attend their lectures regularly; that was wrong. More-

of weights and measures. Coupled with this come expressions of lively regret that the majority of French people in the provinces obstinately refuse to adopt these weights and measures, and stick to the local systems, which vary as much as they do in England. But, then, the people are used to them, and they have no wish to go to school again.

I have only one more piece of information, and that is that some spinners at Lille, MM. Mallard and Bonneau, state that China grass is a perfect substitute for cotton, or that the two may be mixed with great advantage. China grass, I believe, is well known in England, but I do not remember whether it has been used in this way. There is some difficulty, it seems, in the carding, but that they expect soon to get over. Equal weights of the grass and Surat cotton are said to make a first-rate yarn. The mixture, or the grass alone, will dye as well as the best American cotton. Some people believe that the grass may be acclimatised and grown in France and Algeria. The Americans had better finish their war.

Mineral Densities.

To the Editor of the CHEMICAL NEWS.

SIR,—My attention has been called to your report of the last meeting of the Chemical Society, in No. 258 of the CHEMICAL NEWS, in which allusion is made to a short paper of mine inserted in the *Proceedings of the Royal Society* (xiii. 64. 240). It appears that Mr. Church in repeating the experiments on garnet, &c., there recorded, has failed to arrive at the results consigned in my note. If the author publishes his observations in the *Journal of the Society*, I shall reply to them when they have appeared; if not, I shall do so, with your permission, in the CHEMICAL NEWS.

It may be, as Mr. Perkin stated at the meeting, that Mr. Church weighed his specimens before they had completely cooled (unless he adopted my method of taking the densities, when such an error would be impossible), but I think his failure is owing to another cause, which will be referred to hereafter.

I am, &c.

T. L. PHIPSON, Ph.D., &c.

London, November 14.

Substitute for Photographic Yellow Glass.

To the Editor of the CHEMICAL NEWS.

SIR,—I see in the *Popular Science Review* that you recommend gelatine treated with AgO, NO_5 as a substitute, when applied to slender fabrics, for yellow glass in the windows of photographic dark chambers and tents. I venture to suggest, as preferable, gelatine dissolved as usual, and mixed with a hot solution of KO_2CrO_3 ; it leaves no pinholes, gives a clear orange tint, is perfectly weatherproof, and is so firm that it admits of the use of a slight fabric which does not itself obstruct the light. The utility of the mixture for this and many other purposes recommended itself to me as a consequence of my use of it when working at photolithography with Mr. Osborne, Wincanton. Mixed with lampblack, it is a capital and lasting pigment. I use it on my blackboard, and it stands any amount of washing after it has been actinised. I jocularly call my blackboard a carbon print. The gelatine and KO_2CrO_3 , either with or without pigments, is also a capital material for coating bottles for substances that require darkness, as the copper solution for sugar-testing, chlorine water, nitrate baths, &c.; the bottle need only be dipped in a moderately strong solution. It will also do in some cases for repairing cracks in glass and porcelain (a matter of some importance here, where replacement is not easy as with you). When the salt is in excess it gives a pretty crystalline moiré appearance, which may have a decorative value, especially when pigments are used. Other uses suggest themselves as occasion requires.—

I am, &c.

W. SYDNEY GIBBONS.

Melbourne.

MISCELLANEOUS.

Lighting and Ventilation.—It is not our province to criticise the drama, but we may point out, among the many improvements introduced by Mr. Horace Wigan into the Olympic Theatre, the admirable mode of lighting and ventilating it. Gas lights are entirely excluded from the auditorium, and the customary chandelier is replaced by a sunlight in the roof, protected by ground glass. It is the only theatre in London wherein one does not breathe that curious, complicated mixture of carbonic acid and animal effluvia of which the atmosphere of a theatre is usually composed; the only theatre where one escapes that brow-heaviness and lassitude so well known to play-goers.

“Our Inheritance in the Great Pyramid.”—

We learn that the Astronomer-Royal for Scotland, armed with a firman giving him full powers, is about to visit the Great Pyramid, with a view of investigating the “Metrology” of that remarkable structure, to which he has recently called attention. Professor Smyth takes out magnesium wire, in order to photograph the interior, especially the mysterious inner chamber and more mysterious coffer.—*The Reader.*

Rapid Reproduction of Pencil Drawings.—

Our attention has been called to a rapid method of reproducing pencil drawings, plans, and sketches, mentioned in the *Invalide Russe* as founded upon an observation made some time ago by M. Villani-Villanis. “Si on humecte avec une solution acidulée un papier sur lequel est tracé un plan ou de l’écriture au crayon de mine de plomb ordinaire,” are his words, “et si on vient à encre ce papier, il arrive que le trait de crayon prend seul l’encre, et qu’on peut ensuite opérer le transport du dessin sur métal ou sur pierre.” Acting upon this hint, Captain Sytenko of the Imperial Artillery, Directeur du Service Photographique de l’Etat Major, found that pencil drawings, after the paper had been moistened with acidulated water and inked as suggested, could readily be transferred to zinc or stone. He has introduced some modifications into the process and invented a portable press, which will be particularly useful in campaigns, where it is often desirable to have a number of copies of a hasty pencil sketch. It does not take more than ten minutes to effect the transfer of the drawing upon a zinc plate or lithographic stone.—*The Reader.*

ANSWERS TO CORRESPONDENTS.

. In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

. All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Vol. IX. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. X. commenced on July 2, 1864, and will be complete in 26 numbers.

J. C. N.—No report so full as our own has been published.

C. Eaves.—You might perhaps get it from Messrs. Bell and Co., Newcastle.

Dr. Adriani.—The letter is much too long for insertion, and is, moreover, almost undecipherable. It lies at our office.

Chemicus.—The filtration suggested is practical on a large scale, but it would probably be too effective for your purpose. The distillation after digestion we know from experience would not answer.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Passivity of Metals, by M. W. HELDT.

THE author has made numerous experiments on the so-called *passive* state of metals—that is to say, that particular state in which the nature of the metal seems to undergo a permanent change by the action of certain agents, and has come to the conclusion that no such state really exists. The phenomena, he states, (1) are all produced simply at the surface of certain metals, those whose nitrates are insoluble in nitric acid, and the passivity belongs to this insoluble layer, and not to a particular electro-dynamic state or to a polarisation. It is only those metals whose nitrates are soluble in diluted nitric acid and insoluble in concentrated acid which present these phenomena.

With copper and tin the insoluble layer is visible to the naked eye; with others it can be seen with a lens. The acidulated water easily removes it, and the metal returns to its normal condition; the lixivium contains nitric acid, the presence of which is easily recognised, and also metallic oxide. With tin it is necessary to scratch or file the surface, because the oxide is insoluble.

His other conclusions are as follow:—

2. Contact of the metal with platinum, in concentrated nitric acid, which, moreover, will attack the metal to a certain point, quickly determines the precipitation of an anhydrous nitrate, and puts an end to all action; the disengagement of gas ceases with the contact of the platinum. With tin the white film of insoluble oxide directly appears, even with diluted acid. With the other metals platinum effects nothing in the diluted acid, because it dissolves the nitrate formed. The contact of the metal with platinum accelerates oxidation, for the insoluble anhydrous salt spreads over all the submerged surface, as if it had been melted and poured over it; and as all these salts are transparent and brilliant, the metal shines through them as if it had not been attacked. This is especially the case with copper.

3. The rust of iron acts in the same way as platinum in concentrated nitric acid, in contact with iron. But in diluted acid it merely prevents the disengagement of gas, and the metal dissolves in the state of nitrate of protoxide, with which the bin oxide of nitrogen forms blackish tints in the liquid. The liquid contains ammonia.

4. The mass of metal has a marked influence on the decomposition of the acid. When in a very divided state, as filings or fine shavings, it will decompose an acid on which, in its compact state, it would exert no effect.

5. In nitrate of lead, silver, and protoxide of mercury, iron acquires none of this so-called passiveness, the metal, when washed, having all the properties of metallic iron.

6. Rust of iron, in contact with iron, precipitates the copper of its sulphate, while without contact of the iron no effect results. It is the same with iron oxidised by calcination at red heat. But iron steeped in concentrated nitric acid, and covered with a film of insoluble nitrate, does not act on the solution of sulphate of copper—not, at least, unless washed or touched in the liquid, with some readily oxidisable metal.

7. Similar results may also be obtained by adding to the nitric acid a liquid in which the nitrate formed will be insoluble or nearly so. Thus zinc is but very slightly attacked in nitric acid, to which absolute alcohol has been added, and mercury is not attacked at all.

8. Lowering the temperature produces the same results by diminishing the solubility of the salts. At 20° , zinc in monohydrated acid becomes covered with a white layer; but on removing the cooling mixture, this layer of nitrate dissolves, and the reaction becomes very violent. Acid with four equivalents of water, which violently attacks zinc at 0° , leaves it with all its brilliancy at 18° .

9. When nitric acid is concentrated to the point at which it either does not attack a metal or attacks it very slightly, the addition of a little nitrous acid or bin oxide of nitrogen determines the reaction, because these two compounds give up their oxygen more easily; but if the bin oxide of nitrogen is absorbed by the addition of sulphate of iron, all action ceases.

10. An iron wire rendered inactive by the coating of anhydrous nitrate touched with a metal, such as copper, zinc, or iron itself, either in the liquid or after withdrawing it, the disengagement of gas recommences, and the chemical action is renewed; this is simply because at the points of contact the unattackable coating has been disturbed; the acid being again in contact with the metal, the oxide of nitrogen which is formed glides between the metal and the coating, and detaches it (?).

11. With nitric acid, carbonates behave in the same way as metals. Fused carbonates of soda and lead are not attacked by concentrated nitric acid; carbonate of baryta may even be placed in contact with boiling concentrated nitric acid without undergoing decomposition. Nitrates of soda, baryta, and lead are insoluble, or nearly so, in concentrated nitric acid; but saltpetre dissolving in it, concentrated nitric acid attacks carbonate of potash—at least, on the addition of alcohol.

12. In contact beneath the acid, with bismuth, tin, iron, or copper, platinum forms with them the element of a pile, of which it is the negative pole. The tin immediately becomes covered with a kind of enamel of white oxide, without any apparent disengagement of gas; with iron, bismuth, and copper, the deposit is like glass—a transparent, brilliant nitrate of peroxide. This current occasions the highest degree of oxidation. In diluted acid, the contact of the platinum has no effect, because the current is not strong enough to condense on the metal sufficient acid to form this salt of peroxide, and prevent the disengagement of gas, which prevents the unattackable coating from adhering to the surface.—*Les Mondes*.

PHARMACY, TOXICOLOGY, &c.

Action of Iodine, Bromine, and Chlorine upon Sugar,
by E. FOUGERA.

I DO not know of any work upon chemistry, or of any chemist, having described the action of iodine upon sugar; yet the changes which take place between these two bodies deserve being studied by scientific men.

I have only to report a series of facts, the result of my experiments since 1856, in the preparation of the syrup of the iodide of iron, which led me to study the action of iodine, bromine, &c., upon sugar.

I have observed the two following facts:—

1. The partial spontaneous decomposition of the syrup of iodide of iron by exposure to the air is arrested at a certain point, and does not go further, even if exposed for several months in a capsule only covered with paper.

2. This syrup, lightly decomposed, or even coloured by the addition of a small quantity of iodine, becomes perfectly white after a long exposure to the sun's rays

or to a moderate heat; replaced in the dark, it resumes its amber colour.

However, two phials hermetically sealed, each containing the syrup of iodide of iron, one coloured by natural decomposition, the other by the addition of a small quantity of iodine, were exposed for a year to the sun's rays, then both the syrups were colourless; and they remained so for more than a year, though they were left in a dark cellar, and in half-filled bottles.

The first fact reverses the old theory of the decomposition of the syrup of iodide of iron, which was explained by the formation of a protoxide of iron and iodo-hydric acid, by means of the decomposition of the water into its two elements, and by the transformation of the protoxide of iron into sesquioxide of iron by the oxygen of the air. Evidently, should the decomposition of the water and of the iodide of iron operate thus, this process should continue to that point when all the iodide of iron is decomposed; this does not take place.

To explain the second fact I asked myself what became of the free iodine? for surely it could not combine itself with the proto-iodide of iron to form a sesqui-iodide; the sesqui-iodide of iron being red, should have remained so; we know, upon the other hand, that water dissolves hardly more than $\frac{1}{7000}$ th of iodine, which, according to some chemists, is transformed into iodic and hydriodic acids. The last question was, then, to know how free iodine acted upon sugar.

To elucidate this question, I made various experiments with iodine and simple syrup. I soon found that, with a moderate and prolonged heat, this metalloïd added to the syrup was subject to a great chemical change.

One to ten grains of iodine, added to one ounce of simple syrup, in a strong bottle closed with a glass stopper, the whole exposed in a water bath at a moderate heat (60° C.), are dissolved little by little, and give the liquid a reddish brown colour; but after several hours, the whole being always kept at the same temperature, the syrup again becomes discoloured. The flask must be cautiously shaken from time to time. The whole operation occupies about forty-eight hours.

In operating with a syrup containing half a drachm of iodine to the ounce, I obtained, with some trouble, however, a similar colourless product.

The greater the proportion of iodine, the more attention is required; and towards the end of the operation, care must be taken to remove the syrup as soon as it turns white.

Arrived at this point, if the preparation is left exposed to heat, it soon colours again; by-and-by the sugar is transformed into caramel; and this burned sugar, quickly destroyed in its turn, gives rise to carbonic acid and to a blackish, light, and spongy substance, partly soluble in water and alcohol. Treated by hydrochloric acid, potash, &c., this substance shows the same reactions as ulmin and ulmic acid. To carry on this operation to the entire decomposition of the sugar, all necessary care must be taken to prevent a fracture of the flask by the expansion of carbonic acid gas, which is formed in quantities, and can be collected.

The more the temperature is elevated, the larger is the proportion of iodine, and quicker is the sugar decomposed.

This white syrup of iodine, or iodinised syrup, has sometimes an aroma of fruit; it is acid, unalterable by air, heat at 100° C. decomposes it; it contains much glucose. Treated with the reagents, it behaves like iodides in general.

These are the facts; the theory remains to be given.

Does the iodine, all or in part, combine with the sugar $C_{12}H_{11}O_{11}I$, or to the glucose $C_{12}H_{14}O_{14}I$, to form iodides similar to the iodide of starch, $C_{12}H_{10}O_{10}I$?

Or rather, in presence of sugar acting as a catalytic agent, should not iodine decompose the water into its elements, hydrogen and oxygen, and unite with them to form hydriodic and iodic acids? If so, these acids, once formed, would decompose the sugar precisely in the same way as the mineral and some other acids.

If not so, what are these acids, and how are they formed? Is it from the decomposition of the sugar or of the water?

Bromine acts upon sugar in the same manner as iodine, with the difference that the diverse phenomena follow more rapidly.

Chlorine acts upon simple syrup still more promptly than bromine; into water freshly saturated with chlorine, at a very cold temperature, I have thrown sugar, and heated the liquor as I have described for iodine. In less than half an hour the chlorine had disappeared, and the liquor was acid.

Chlorine was probably transformed into hydrochloric acid.—*American Journal of Pharmacy.*

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

Thursday, November 17.

General SABINE, President, in the Chair.

A PAPER, by Mr. Huggins, "*On the Spectra of some of the Nebulæ*" was read. The paper was a continuation of that on the spectra of the fixed stars by Mr. Huggins and Professor W. A. Miller. The former paper showed the similarity of essential constitution which exists among the stars, and between them and our sun. The present examination was undertaken to ascertain whether the same similarity extended to the nebulæ. Prismatic analysis seemed to be a method of observation specially suitable for determining whether any essential physical distinction separates the nebulæ from the stars, either in the nature of the matter of which they are composed, or in the conditions under which they exist as sources of light. For increase of optical power alone fails to give the desired information, since the researches of Lord Rosse have shown at the same time that the number of clusters may be increased by the resolution of supposed nebulæ, other nebulous objects are revealed, and fantastic wisps and diffused patches of light are seen which it would be assumption to regard as due in all cases to the united glare of suns still more remote. The nebulæ selected for examination were those which present small round or oval discs, and therefore classed by Sir John Herschel as planetary nebulæ. They present but little indication of resolvability, have a green and sometimes bluish colour, and show no sign of central condensation. The first examined was a nebula in Draco 37, H. iv. The light of this nebula, unlike that of any other ex-terrestrial body examined by the author, was not composed of light of different refrangibilities, and therefore could not form a spectrum. A greater part is monochromatic, and, after passing through the prisms, remains concentrated in a bright line, occupying in the instrument the position of that part of the spectrum to which its light corresponds in refrangibility. A more careful examination with a narrower slit showed that a little more refrangible than the bright line, and separated from it by a dark interval, a narrower and much fainter line occurs. Beyond this, again, at about three times the distance of the second line, a third exceedingly faint line was seen. The position of these lines in the spectrum were determined by a simultaneous comparison of these with the spectrum of the induction

spark taken from electrodes of magnesium. The strongest line corresponds in position with the brightest of the air lines; this line is due to nitrogen, and occurs in the spectrum about midway between b and F of the solar spectrum. The faintest of the lines of the nebula agree in position with the line of hydrogen corresponding to Fraunhofer's F. The other bright line was compared with the strong line of barium 2075; this line is a little more refrangible than that belonging to the nebula. Besides these lines, an exceedingly faint spectrum was just perceived for a short distance on both sides of the group of bright lines. The author suspects that this is not uniform, but crossed with dark spaces; subsequent observations on other nebulae induced him to regard this faint spectrum as due to the solid or liquid matter of the nucleus, and as quite distinct from the bright lines into which nearly the whole of the light from the nebula is concentrated. The colour of this nebula is greenish blue. In most of the other nebulae examined the three bright lines were seen in the same positions, and in some a fourth line was observed. With regard to the nebula the spectrum of which we have just described, and some others, the author observes that they can no longer be regarded as aggregations of suns after the order to which our own sun and the fixed stars belong, but objects possessing a distinct and peculiar plan of structure. In place of an incandescent solid or liquid body transmitting light of all refrangibilities through an atmosphere which intercepts by absorption a certain number of them, such as our own sun appears to be, we must probably regard these bodies, or at least their photo-surfaces, as enormous masses of luminous gas or vapour; for it is alone from matter in the gaseous state that light consisting of definite refrangibilities only, as is the case with the light of these nebulae, is known to be emitted. It is, indeed, possible that suns endowed with these peculiar conditions of luminosity may exist, and that these bodies are clusters of such suns; but there are considerations which are scarcely in accordance with the opinion that they are clusters of stars. One of these is found in the extreme simplicity of constitution suggested by the three bright lines, whether or not these are regarded as indicating the presence of nitrogen, hydrogen, and a substance unknown. With the exception of nitrogen, the author states that not one of the thirty elements, the spectra of which he has measured, has a strong line very near the bright line of the nebulae. If, however, this line were due to nitrogen, other lines should be seen; for there are specially two strong double lines in the spectrum of nitrogen, one at least of which, if it existed in the light of the nebulae, would be easily seen. In the author's experiments on the spectrum of nitrogen, he observed that the character of the brightest of the lines, that with which the line in the nebulae coincides, differs from that of the two double lines next in brilliancy. It is more nebulous at the edges, even when the other lines are thin and sharp. The same phenomenon was observed with other elements. May not this difference of character observable in the lines of the same element indicate a physical difference in the atoms in connection with the vibrations of which they are probably produced? The speculation presents itself whether the occurrence of this one line only in the nebulae may not indicate a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect.

The next paper was by Forchammer, on the composition of sea water at different depths, a report of which we are compelled to defer.

Simpson v. Holliday.—This case is now before the Lord Chancellor on an application by the defendant for a new trial, or the reversal of the decision of Vice-Chancellor Stuart. Our readers are by this time well acquainted with the matters in dispute, and we shall not further allude to the case until the decision of the Chancellor is given.

CHEMICAL SOCIETY.

Thursday, November 17.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,
in the Chair.

THE minutes of the previous meeting having been read and confirmed, and the donations to the library acknowledged, the names of thirteen candidates for admission into the Society were read over for the second time, and Mr. Alexander Stuart, Apothecaries' Hall, London, was proposed for the first time.

We subjoin a complete list of the names which will be balloted for at the next meeting of the Society (December 1):—Clayton S. Beauchamp, Lieutenant Royal Engineers; Mr. John Bray, High Street, Mild Town, Sheerness; Mr. Charles Eken, Bath; Mr. Henry Haywood, Broomhall Park, Sheffield; Henry Montague Hozier, Lieutenant 2nd Life Guards, Topographical Department, New Street, Spring Gardens; Mr. Daniel Harmer Jay, Manufacturing and Analytical Chemist, Frog Island, Leicester; Mr. Joseph F. Payne, M.A., Magdalen College, Oxford; Mr. J. G. F. Richardson, Manufacturing Chemist, Leicester; Mr. William White Rouch, Norfolk Street, Strand; Lieut.-Colonel H. Y. D. Scott, Royal Engineers, Ealing and South Kensington Museum; Mr. J. Berger Spence, Pendleton Alum Works, Newton Heath, Manchester; Hermann Sprengel, Ph.D., Chemical Works, Kennington Common; and Mr. Alfred Phythian Tamar, 3, Upper Baker Street, London.

A resolution of the Council, referring to the proposed removal from the list of Fellows some few members who have allowed their subscriptions to lapse for more than three years, was read a second time, and will likewise be decided by ballot at the next meeting.

The PRESIDENT then invited Dr. Marcet to favour the Society with his promised communication "*On the Brine of Salted Meat.*" The author commenced by pronouncing a graceful eulogium upon Professor Graham's researches on Liquid Diffusion or Dialysis. Very shortly after these results were made known Dr. Marcet conceived that the principle might be turned to account advantageously in connexion with the curing of meat, and two years ago he instituted experiments upon the treatment of meat brines with the view of removing the salt by dialysis. He evaporated the salt brine at a moderate temperature to one-third its original bulk, decanted from the crystals of common salt which had separated, and placed the liquid in a dialyser for the purpose of removing the rest of the salt. He obtained in this manner, in periods varying from eighteen to thirty-six hours, a palatable beverage, which had only to be warmed in order to furnish a good and cheap soup. So important did these results appear, that Dr. Marcet wrote at once to a friend in Liverpool advising him to make a trial of the plan for the benefit of the distressed Lancashire operatives; the author did not, however, entertain any intention of publishing his experience until he had found opportunities of further pursuing the matter, for although the liquid had the smell and taste of broth he could not then say whether there was a deficiency of nutritive ingredients, and later he found that much of the phosphates and lactates, kreatin and kreatinin were lost. In the meantime, however, a short account of his experiments appeared in the *Family Herald*, without his knowledge or sanction, early in the year 1863. Since then he had resumed the subject for the purpose of turning a waste commodity, if possible, to some practical account, and he considered that meat brine was admirably adapted to the preparation of kreatin and kreatinin, and could be used as a source of lactic acid. The process employed in the recovery of these constituents was first to boil the brine in order to coagulate the albumen; this being strained off the liquor was evaporated until much of the salt had crystallised out, alcohol was then added, and to the clear fluid a small quantity of a

highly concentrated solution of chloride of zinc; then set aside in order to permit of the gradual deposition of crystals of lactate of zinc, but inasmuch as some of the lactic acid and all the kreatin, &c., remained in solution, he treated the mother liquor with oxide of lead, which effected a complete separation of the acid from the neutral substances. The lactate of lead was transformed into the characteristic lime salt (exhibited) by boiling the precipitate with sulphuric acid and then neutralising with chalk. The kreatin and kreatinin were recovered by evaporating the solution to dryness and treating with alcohol, in which the latter is very soluble, the kreatin was afterwards taken up by water and crystallised from aqueous solution. In the course of these researches the author observed an anomaly in the fact that very large quantities of albumen were dissolved out from muscular tissue by the action of water; he started with the supposition that flesh was a colloid, and, as such, would not permit of the outward diffusion of albumen. This experimental result stood apparently in opposition to the laws of liquid diffusion, but there was a difference in the character of albumen, that contained in blood requiring a higher temperature to coagulate it than the albumen of flesh. In order to make this point more clear, Dr. Marcet showed at the meeting the comparative results of two experiments: one was a piece of beef merely immersed in water to which it had already in the course of the day imparted a red colour and some soluble albumen, whilst in a second glass some juice of flesh inclosed securely within a pig's bladder showed no signs of albumen after twelve hours. The structure of a piece of muscular tissue cannot then bear any comparison with an ordinary colloidal septum, as was at first supposed. Further, if a piece of flesh be immersed in liquid gelatine and the whole allowed to set, no albumen passed out until the sixth or seventh day, when a red zone appeared in the jelly around the meat and faintly coloured the isinglass. The author next made experiments of a similar kind, but with very delicate animal membranes, such as that which covers the liver in the ox and sheep. This membrane, thin as gold-beater's skin, was made into dialysers, which being charged with juice of flesh allowed variable quantities of albumen to pass during the first day. The structure of flesh must, therefore, be defined as consisting of an infinite number of delicate membranes through which the liquids may constantly circulate by capillary motion. Dr. Marcet next addressed himself to the following inquiry?—Are the various soluble constituents of meat equally diffusible? and, particularly, whether is albumen or phosphoric acid more readily transmitted through animal membranes? For a truly comparative experiment the author made quantitative analyses of the aqueous extract of beef, and of the aqueous diffusate from a precisely similar quantity of beef. Two hundred grammes of meat were treated in each case with 125 cubic centimetres of distilled water, and it was found that, in the case of the extract, the phosphoric acid was in proportion to the albumen as 1 : 12.5, whilst the liquid diffusate, after twenty-six hours, contained the same constituents in the ratio of 1 : 6.3; thus it was proved that the albumen was only half as diffusible as the phosphoric acid. In another experiment, which lasted four days and confirmed the former result, the ratios of phosphoric acid to albumen were respectively 1 : 9.5 in the extract, and 1 : 4.4 in the aqueous diffusate. The speed at which albumen will pass through an animal membrane is, however, mainly regulated by the degree of acidity or alkalinity of the fluid, and the author found that when the liquid was decidedly alkaline, a mere trace only of albumen was allowed to pass. The same observation was equally applicable to the dialytic analysis of urine, and was particularly noticed when baryta water had been employed in slight excess for the purpose of precipitating the phosphates and sulphates. Reverting to the practical part of the question, Dr. Marcet

pointed out the fact that not only was there a loss of nutritive constituents during the process of salting, but when subsequently it was desired to cook the meat it was usually immersed for some time in pure water to remove the great excess of salt. Here, likewise, there was a waste of valuable constituents which could by a modification in the treatment be avoided. The author proposed to cut the meat into small pieces, add from 10 to 20 per cent. of common salt, and fill into sausage skins or bladders. The whole should then be immersed in a concentrated brine until the meat was deemed to have been sufficiently impregnated throughout. At the end of a month, during the hottest season of last year, the meat was found upon trial to have a better flavour and to be more tender than that cured in the usual way. If desired, much of the salt could be removed from the sausage meat by soaking the skins in fresh water; and the author, in conclusion, recommended that whenever it was necessary to remove the excess of salt from meat, cured either on this principle or in the ordinary manner, the joint should be securely wrapped in a bladder before being introduced into water, and thus a considerable proportion of the nutritive matters be retained.

The PRESIDENT felt greatly interested in the subject of Dr. Marcet's investigation. It was well known that waste occurred; the question to be settled was how this could best be avoided. He wished to ask the lecturer whether in the experiment before them he relied upon the red colour of the liquid as being the sole indication of the presence of albumen?

Dr. MARCET replied that he always found the red colouring matter accompanying the albumen; there was no philosophical reason for this being the case, but chemical tests invariably proved it. The red blood-corpuscles were, of course, destroyed, and their coloured contents became mixed with the albumen.

Professor GRAHAM considered that the lecturer had treated of muscular mass too much in the light of a homogeneous substance; it would be better to distinguish between the fibrous and fluid ingredients somewhat as water in a sponge, and if then by mechanical forces the meat suffered contraction, as when immersed in salt, the fluids were ejected as a necessary consequence, and not so much by virtue of a dialytic action, as had just now been represented. If threads of fibrin were soaked first in acetic acid, and then removed into salt-brine, they would be found to contract very considerably. With regard to the dialytic transfer of albumen, the speaker thought it desirable to make further experiments before this could be confidently asserted; it was necessary to bear in mind the difficulty of procuring absolutely perfect dialysers, animal membranes were never water-tight, and even thick bladders had sensible apertures through which albumen itself could flow out, especially under the pressure of a few inches of water. It was always necessary to take the precaution of testing the dialysers before their employment.

Dr. MARCET could not allow that the structure of muscular tissue bore any comparison with water in a sponge, for he had never succeeded in expressing any liquid from a piece of meat, even under a hydraulic press; it was impossible to get evidence upon a dry sheet of filter paper of the expulsion of more than traces of fluid or moisture; then it must be remembered that he had employed pure water, not brine, in the experiments by which albumen had been extracted; meat always contracts and becomes hardened under the influence of salt. With respect to the preparation of the animal membranes, he had torn them from the sheep's liver in preference to removing them by the aid of a dissecting knife, so as purposely to shut out this source of error.

Dr. A. W. HOFMANN referred briefly to the new plan proposed by Dr. Morgan, of Dublin, for salting animals whole. Immediately after slaughtering, a communication was established between the principal arteries and a reser-

voir of salt brine placed at a high-level, the effect of which ensured the diffusion of salt through the meat by a process of injection. The published statements affirmed that for the cost of sixpence halfpenny, and in the course of ten minutes, a whole ox could be preserved.

Dr. PAUL made a further statement on the same subject, and said that the quantity of salt might now be so much diminished that it became unnecessary to wash the meat preparatory to cooking.

Dr. CRACE CALVERT warmly advised the undertaking of chemico-physiological experiments in connection with the intestinal absorption of food.

A paper was read by Professor WANKLYN "On the Nature of Compound Ethers," an abstract of which shall appear in our next number.

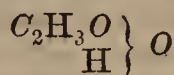
The meeting was then adjourned until December 1.

LECTURES ON CHEMICAL PHILOSOPHY.—VII.

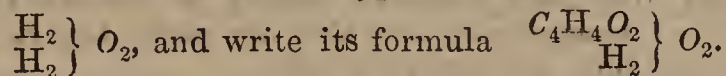
Delivered at the College of France, by M. A. WURTZ.
Condensed Types.

WE have seen the advantages of the theory of types in two respects—in the clearness with which it enables us to interpret the metamorphoses of bodies, and in the relationship it establishes between mineral and organic compounds. Let us now pursue the subject further and apply the theory to a higher order of compounds. We shall treat to-day of *condensed types*, and follow the relations which the typical notation establishes between certain groups of mineral and organic compounds, and endeavour further to account for the part which polyatomic radicals play in the generation of complex compounds.

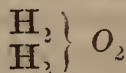
We have already explained the real meaning of the typical formula of acetic acid



which expresses at once the principal facts of the history of this acid. Let us now consider succinic acid:—We bring this acid under the type of water twice condensed

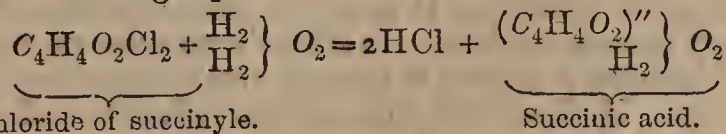


This formula explains that succinic acid is derived from



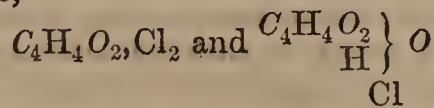
by the substitution of $C_4H_4O_2$ for H_2 ; in other words, that it is diatomic.

The following equation,—



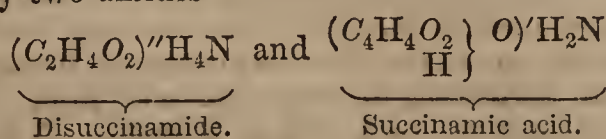
indicates, in fact, that the formation of the acid is effected by a double substitution which implies the equivalence of $C_4H_4O_2$ to H_2 and to Cl_2 ; that is to say, implies the diatomicity of succinyle, and consequently of the acid.

The typical formula suggests that succinic acid can form two kinds of salts and two kinds of ethers according as we replace one or two atoms of the typical or extra-radical hydrogen by one or two metallic atoms, or one or two molecules of alcoholic radicals; that the acid can form two chlorides according as we replace one or two of the groups HO by chlorine,



Chloride of succinyle. Chlorosuccinic acid.

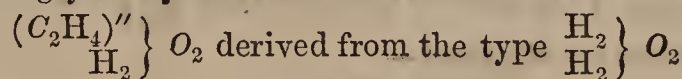
and lastly two amides



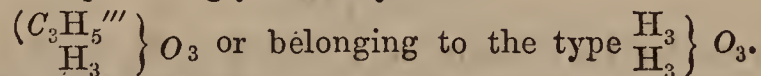
according as we replace one or two of the groups HO by

NH_2 . Thus these typical formulæ express very clearly the manner in which all these bodies are derived from succinic acid, and the bonds which unite them to it. We may remark further that the notation allows us to foresee the existence of a chloro-succinic acid, a sort of succinic chlorhydrine which has not yet been prepared.

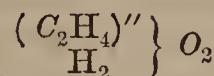
The formulæ by which we represent the polyatomic alcohols give us the same kind of information. We represent glycol by



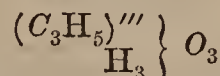
and we represent glycerine by



The formula of glycol

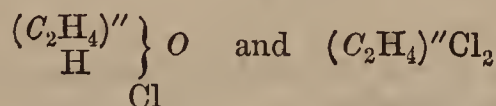


indicates to us that in this compound one or two atoms of hydrogen are replaceable by one or two atoms of acid radicals; that one or two groups HO^* may be replaced by Cl , Br , or NH_2 . The formula of glycerine

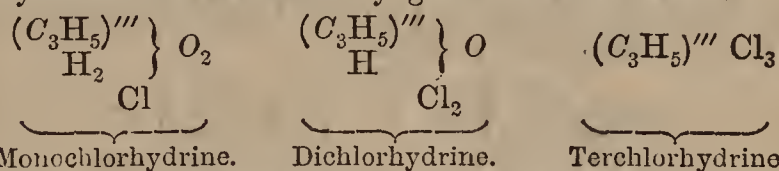


teaches us that in this compound one, two, or three atoms of hydrogen, and one, two, or three molecules HO may be exchanged for new elements or new groups to form a multitude of compounds, the existence of which we can thus foresee, and the conditions of whose formation we can determine.

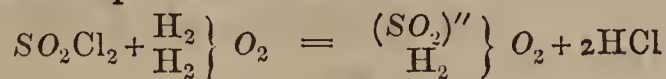
Glycol, for example, in this way gives rise to two chlorides—



Glycerine in the same way gives three chlorides—



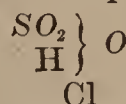
Let us now see whether any compounds exist in mineral chemistry which we can compare with the foregoing—that is to say, which we can bring under the type of condensed water. Let us compare succinic with sulphuric acid. The former we have said is formed by the reaction of chloride of succinyle upon water. Well, it is the same with sulphuric acid. When chloride of sulphuryle reacts upon water sulphuric acid is formed:



Chloride of sulphuryle.

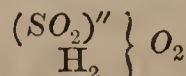
Sulphuric acid.

The diatomic radical $(SO_2)''$ exists; it is ordinary sulphurous gas. It combines directly with chlorine to form chloride of sulphuryle (Regnault's chlorosulphuric acid). This chloride results from the substitution of Cl_2 for $2(HO)$ in a molecule of sulphuric acid. By treating sulphuric acid with perchloride of phosphorus Williamson obtained the true chlorosulphuric acid



which results from the substitution of Cl for HO in sulphuric acid.

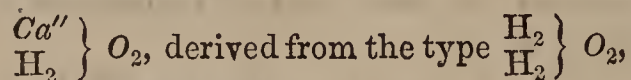
Thus, sulphuric acid forms two chlorides; it forms also two kinds of salts and two kinds of ethers. The formula



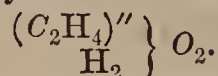
* To exhibit this mode of replacement more clearly, we might write the formula of glycol $(C_2H_4)'' 2(HO)$, and that of glycerine $(C_3H_5)''' 3(HO)$.

shows us all that at a glance; it clearly expresses all the principal properties of this acid, which you now see we are justified in comparing with succinic acid, and regarding as a bibasic and diatomic mineral acid.

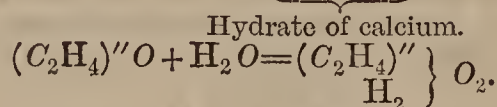
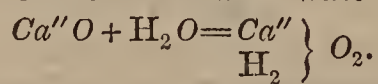
We have already compared the alcohols of organic chemistry to the hydrates of mineral chemistry. Thus, to hydrate of lime—



we have compared glycol—



This comparison is formed on a perfect similarity of metamorphoses. Hydrate of calcium is formed by adding water to lime. Glycol is produced in just the same way by placing oxide of ethylene in contact with water.

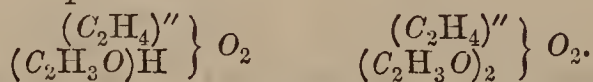


Oxide of ethylene. Hydrate of ethylene (glycol).

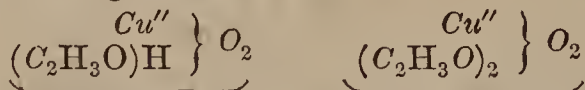
In the same way we are justified in comparing hydrate of ethylene to the hydrates of some other diatomic metals. The typical formula of glycol indicates to us that this body may form two kinds of salts, just as the formula of the hydrate



teaches us that two kinds of cupric salts can exist. Thus, by combining with acetic acid, glycol gives rise to the two following compounds:—



In the same way cupric hydrate forms with acetic acid the two following acetates:—

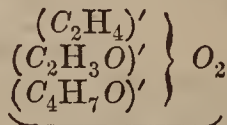


Bibasic acetate of copper. Neutral acetate of copper.

We thus compare the ethers of glycol to the cupric salts, and the typical notation shows that this analogy is founded upon the similarity of reactions.

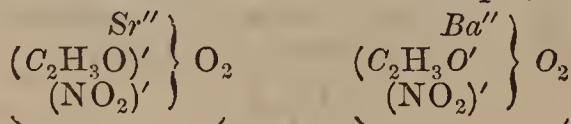
Just as on adding hydrate of potassium to cupric acetate we form acetate of potassium and cupric hydrate, so on adding hydrate of potassium to acetate of ethylene, we form acetate of potassium and ethylenic hydrate or glycol.

Again, with glycol we can form ethers with two acid radicals such as—



Aceto-butyric glycol.

In mineral chemistry we have salts with two radicals exactly similar, aceto-nitrates, for example, such as—



Aceto-nitrate of strontium. Aceto-nitrate of barium.

(To be continued.)

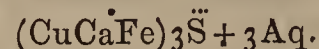
ACADEMY OF SCIENCES.

November 14.

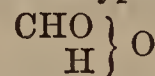
THE first memoir read was by Dr. Hofmann, and entitled "Further Contributions to the History of the Colouring Matters derived from Coal Tar: Phenyltolylamine." The paper has already been communicated to the Royal

Society, and was published in the last number of the *Proceedings*, from which we may make an abstract.

M. Pisani presented a note "On a new Cornish Mineral" which he has named *Deville*. In reference to this paper we must call the attention of our readers to a note by Mr. Maskelyne in our "Correspondence." According to M. Pisani, *Deville* has the composition—



M. Oppenheim made a communication "On the Heat of Combustion of Formic Acid." Berthelot, from his synthetic experiments, regards formic acid as carbonic oxide plus water, but he has been puzzled by the observation that its combustion disengaged more heat than that of carbonic oxide, the water in the acid furnishing none. He concluded that in its formation some absorption of heat takes place, which is to M. Berthelot inexplicable. M. Oppenheim thinks that the typical formula of formic acid



explains it. The formula shows that formic acid is not a simple compound of carbonic oxide and water, but a combination of the radical formyle with peroxide of hydrogen. Thus in its formation water is decomposed into H and HO, the H first uniting with carbonic oxide to form formyle, which then combines with HO. This decomposition of water the author considers occasions the absorption of heat. In like manner, when the formic acid is produced according to Kolbe's method by the action of carbonic anhydride and potassium on the vapour of water, carbonic anhydride splits up into CO and O, in which case, also, absorption of heat takes place, and thus the heat of combustion of formic acid is equal to that of the combustion of carbonic oxide plus the heat absorbed in its formation, and the absorption is explained by the decomposition of the water or carbonic acid. The author further expresses an opinion that the facts mentioned show the influence which the position an atom occupies in a compound has upon its physical properties, and believes that the theory of types, originally intended merely to indicate the reactions of compounds, may also be made the means of expressing their physical properties.

M. Berthelot, in a note "On Formic Acid," questions this; he says that the explanation of the anomaly observed must be sought through physical and mechanical experiments, and not in the imaginary arrangements of a formula. He shows that in the union of carbonic oxide and water, the synthesis of formic acid is direct, and no accessory products are formed. It is in this case that the calorific anomaly is most evident. In Kolbe's experiment, a quantity of hydrate of potash is formed, which must have some influence. M. Berthelot then compares formic with acetic acid, acids belonging to the same series, and comparable by their chemical constitution, whatever formulæ they may be represented by. But the combustion of acetic acid disengages the same amount of heat as the combustion of the products of its decomposition, carbonic acid and marsh gas, or carbonic acid, water, and acetone. No formula, he adds, will enable us to foresee the calorific properties of formic acid. In conclusion, M. Berthelot announces the speedy publication of a memoir, in which he will show that the vapour of formic acid submitted to a high temperature decomposes with a considerable disengagement of heat, and that the decomposition may be at will into carbonic oxide and water, or carbonic acid and hydrogen.

MM. Caron and Margueritte continue their dispute about the cementation of iron by carbons and carbonic oxide. The former says that soot will not make steel any more than graphite. The latter says what he has said before.

Two notes, one by M. Des Cloizeaux, and the other by M. Daubree, announce the discovery of Breunnerite, a crystallised carbonate of magnesia and iron, in the remarkable meteorite which fell at Orgueil. A third note, by M. Cloez, announces that the same meteorite contained

a little more than one-half per cent. of carbonic acid—small facts, but valuable, since the presence of this crystallised carbonate proves that the meteorite could never have been exposed to a very high temperature.

NOTICES OF BOOKS.

Elements of Chemistry: Theoretical and Practical. Part II. Inorganic Chemistry. Third Edition, with additions. By WILLIAM ALLEN MILLER, M.D., L.L.D., &c., &c. London: Longman and Co. 1864.

THE sale of two editions of an educational work on the scale of Dr. Miller's "Elements of Chemistry," may be taken as a proof of the esteem in which it is held, and it is only necessary for us to point out the new features of this edition.

In the present state of chemical science we might say it has become a difficult matter to write a completely satisfactory educational work on chemistry. An author has two courses open to him. He may adhere to the old notation, and give in an appendix an account of new theories and systems of notation, or he may construct his book entirely upon recent theories, and leave all previous notations out of consideration. Neither of these plans we think, is altogether satisfactory. A student may never read an appendix, and consequently remain in ignorance of what it is very desirable that he should know; and if he have studied only the new notation he runs the risk of being mystified whenever he takes up a book on the old. We are thinking of a student who does not devote himself exclusively to chemistry, but who should be so taught the elements of the science that he may supplement his knowledge from our current literature, which has no system.

In this volume Dr. Miller has adopted the new atomic weights, and written all the formulæ according to it. He has, however, placed at the beginning a general note as follows:—

"N.B.—In the formulæ adopted in this volume the symbols for the new atomic weights are in accordance with the present usual and convenient practice, indicated by barred letters, instead of by italics as in the first volume. The conversion of any formula on the new notation into that in ordinary use is effected by doubling the numbers attached to the barred symbols. The result will be either the ordinary formula or its multiple by two. $\text{KH}\bar{\text{O}}$, for instance, = KHO_2 ; and $\text{SnCl}_4 = 2\text{SnCl}_2$."

When we have quoted this, and said that large additions have been made to this edition to bring the work up to the present state of the science, we have said all that is necessary to convince our readers of its value as an introduction to the study of chemistry.

A Manual of Qualitative Analysis. By ROBERT GALLOWAY, F.C.S. Fourth Edition. Revised and Enlarged. London: Churchill and Son. 1864.

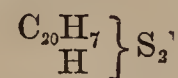
WE can always give praise to Mr. Galloway's educational works. They are invariably written upon a system and founded on experience, and the teaching is clear, and in general complete. Few works on qualitative analysis have been more studied than the previous editions of this manual, and the present edition will commend itself to teachers and students by some marked improvements. Nevertheless, it would not be difficult to find fault with the book. The system does not appear to us perfect. We are puzzled, for instance, on reading par. 27 by finding an asterisk directing us to a foot-note which tells the student to pass on to par. 96, the information given between these two paragraphs being absolutely necessary for the proper understanding of what follows. We notice also some small omissions. The author, for instance, forgets to mention that most delicate and characteristic test for sulphur, nitroprusside of sodium. We object also to the

constant use of marks of quotation with and without references to the authorities. These quotations swell the book to unnecessary dimensions, when the simple mention of a fact with a reference at the bottom of the page would answer every purpose. Lastly, we would recommend Mr. Galloway to reconsider Part II., the greater part of which might well be omitted from this book, and largely added to in a separate work. The subject of systematic proximate organic analysis has not yet received the attention it deserves.

Annalen der Chemie und der Pharmacie. October, 1864.

(Continued from page 250.)

THE next paper is by Arnulf Schertel "On Sulphonaphthalic Acid and Bisulphide of Naphthalin." Vogt has shown that by the action of nascent hydrogen chlorosulphophenylic acid is changed into phenylmercaptan, and Kolbe had speculated that in a similar way chlorosulphonaphthalic acid would be changed into sulphhydrate of naphthalin



and bisulphide of naphthalin $(\text{C}_{20}\text{H}_7)\text{S}_2$.

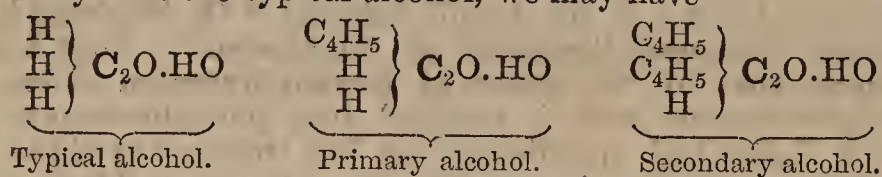
The author's experiments proved that these changes really take place. He kept the chlorosulphonaphthalic acid in contact with nascent hydrogen (from zinc and dilute SO_3) for twenty-four hours, and then by distillation obtained a heavy disagreeable smelling oil, which, after rectification, was analysed, and found to be the sulphohydrate expected. It is a light, refractive liquid, with a faint disagreeable odour, is soluble in ether and alcohol, but not miscible with water. Like all mercaptans it easily exchanges an atom of hydrogen for a metal.

The author describes the compounds with mercury, lead, and copper. An alcoholic solution saturated with ammoniacal gas, and left in the air for some days, deposited yellow transparent crystals of bisulphide of naphthalin, $\text{C}_{20}\text{H}_7\text{S}_2$. This body on treatment with nascent hydrogen reverts to the former compound.

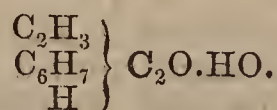
This paper is followed by a communication, "On Some Derivatives of Mucic Acid," by F. Bode. Lies-Bodart had observed that mucic acid heated with pentachloride of phosphorus, and treated with water, gave rise to a new acid with the composition— $2\text{HO}, \text{C}_{12}\text{H}_2\text{Cl}_2\text{O}_6$. The author has further examined this acid, and some of its salts, and an ether. He obtained the acid by heating six equivalents of pentachloride of phosphorus with one equivalent of mucic acid in a retort. As the temperature rose oxy-chloride of phosphorus distilled over. At 120°C . the distillation was stopped, and the residue in the retort was poured into a large quantity of water, whereupon the new acid separated as a white, sandy powder. There seems to be nothing peculiar in the behaviour of the acid or its salts. When this acid is submitted to the action of sodium amalgam and water, another acid, free from chlorine, is obtained— $2\text{HO}, \text{C}_{10}\text{H}_4\text{O}_6$ —to which the author has given the name *Muconic acid*. This acid only differs from itaconic acid— $2\text{HO}, \text{C}_{10}\text{H}_4\text{O}_6$ —by two atoms of carbon and two of hydrogen, and from adipinic acid— $2\text{HO}, \text{C}_{12}\text{H}_8\text{O}_6$ —by two of hydrogen. The author endeavoured to prepare an acid— $2\text{HO}, \text{C}_{12}\text{H}_4\text{O}_6$ —and also to convert muconic into adipinic acid by the action of nascent hydrogen, but without success. The most peculiar property of muconic acid is the readiness with which it etherifies. It is only necessary to heat the acid with absolute alcohol to obtain a large amount of ether, which is a colourless, oily fluid, heavier than water, with an agreeable odour.

A paper, "On Secondary Alcohols," by Kolbe, gives the author's views of the constitution of Wurtz's "Hydrate of Amylene." It will be remembered that by treating pure amylic alcohol with chloride of zinc Wurtz obtained amylenes $\text{C}_{10}\text{H}_{10}$. With this body he formed the compound $\text{C}_{10}\text{H}_{10}\text{HI}$, and now, on treating the latter com-

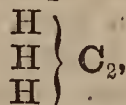
pound with moist oxide of silver, he eliminated the iodine and fixed a molecule of water, thus forming a body the composition of which is represented by $C_{10}H_{10}, H_2O$, a body isomeric with amylic alcohol, and which Wurtz calls hydrate of amylene. Beyond identity of ultimate composition, this compound has nothing in common with amylic alcohol, and the question arises what is it to be regarded as? Wurtz's own views on the question we shall have occasion to give presently. Kolbe, we may say shortly, regards it as a *secondary alcohol*. By a secondary alcohol the author means a body in which two of the typical hydrogen atoms in a typical alcohol are substituted by two atoms of some other alcohol radicals. Thus, starting with methylic as the typical alcohol, we may have—



Now, from a consideration of the behaviour and boiling-point of pseudo-amylic alcohol, Kolbe is brought to regard it as a secondary alcohol, made up in the way represented by the formula



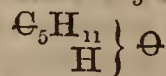
and to which he gives the name *Propyl-methyl-carbinol*. The word *carbinol* requires some explanation. In his work on organic chemistry the author has given the name *Carbin* to the typical radical



the hydrated oxide of which he designates *Carbinole*, to save the use of the longer German term, *Carbinoxydhydrat*. The whole of this most ingenious paper forms a very interesting study. We must again pass over some other papers for the present.

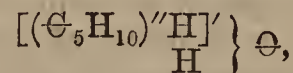
Annales de Chimie et de Physique. October, 1864.

IN this Journal we have Wurtz's "*Memoir on Isomerism in Alcohols and Glycols*," the first part of which is devoted to the above-named hydrate of amylene and its derivatives. We may mention in passing that this pseudo-amylic alcohol, when submitted to the action of oxidising agents, does not furnish valeric acid, but a complex mixture composed principally of acetic acid, with which are found hydrate of butylene and various acetones. There are other differences quite as marked between the behaviour of the pseudo and the true amylic alcohol. Thus, true amylic alcohol and its derivatives only yield amylene under the influence of strong reagents, such as chloride of zinc, while hydrate of amylene and its derivatives furnish amylene on the smallest provocation. The hydrate itself breaks up into amylene and water when simply heated; the acetate splits into amylene and acetic acid when it is heated. The hydriodate breaks up under the influence of ammonia. With regard to the constitution of the pseudo alcohol, the author states that when naming it hydrate of amylene, he did not mean to convey the impression that he regarded it as a binary compound of water and amylene, according to the dualistic theory. The real condition of things in the two alcohols he understands to be as follows. In true amylic alcohol five atoms of carbon (Wurtz uses the new atomic weights, Kolbe uses the old) are in direct relation or close connexion with eleven atoms of hydrogen. The twelfth unit of affinity necessary to saturate \ominus_5 is furnished by the diatomic oxygen, which is in connexion with the last atom of hydrogen. The formulæ $\ominus_5H_{11}, \ominus H$ or



express these relations perfectly. Now, in the hydrate of

amylenic or pseudo alcohol the author thinks that the eleventh atom of hydrogen is not so strongly united as the corresponding atom in the amylic group \ominus_5H_{11} . This eleventh atom of hydrogen is that which the hydriodic acid fixed upon the amylene on combining with it \ominus_5H_{10}, HI . In the hydrate, in which the group $\ominus H$ replaces the iodine, the eleventh atom becomes somehow part of the radical, and saturates the affinities of a certain atom of carbon, but since it is very easily separated it seems as if this eleventh atom of hydrogen was in connexion with the entire amylenic group, the atomicity of which is thus reduced by one unit. This view is expressed by the formula



which gives us to understand that hydrate of amylene is not, properly speaking, a binary compound of amylene and water (for water does not exist in it ready formed), but that its molecule may very easily break up in the way its name suggests. We may expect a long dispute between Wurtz and Kolbe respecting the nature of this body.

The other papers in this number of the *Annales* are—the memoir "*On Pyroxylin*," by Pelouze and Maurey, which we have already published; "*Researches on Hydrocyanic Acid*," by Bussy and Buignet, some account of which we gave in our last volume; and some "*Researches on the Organic Matters in Water*," by Peligot, which last requires some notice.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2311. Léonard Cooke, Horwich, Lancashire, "Improvements in the manufacture of paper cloth."—Petition recorded September 21, 1864.

2497. John Ives Vaughan, Appleton-in-Widnes, Lancashire, "Improvements in the manufacture of resins and resinous substances, and in the apparatus employed therein, parts of such improvements being also applicable to the refining of coal, petroleum, and bone oils, and also paraffine and analogous acids and hydrocarbons."—Petition recorded October 11, 1864.

2511. Johannes Möller, Shaftesbury Villas, Hornsey Rise, Islington, Middlesex, "Improvements in the preparation or manufacture of colouring matter for marking-ink and other purposes."—Petition recorded October 12, 1864.

2594. Louis Henry Gustavus Ehrhardt, Richmond Road, Bayswater, Middlesex, "Improvements in the manufacture of gunpowder, and in flasks to contain the same."—Petition recorded October 20, 1864.

2635. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of aerated bread by the application of carbonic acid gas obtained from fermenting vegetable matters, and in the apparatus employed therein."—A communication from Struben Taylor Bacon, Boston, U.S.A.—Petition recorded October 24, 1864.

2646. Peter Dutrulle, Davis Street, Grosvenor Square, Middlesex, "Improvements in the manufacture of syrups."—A communication from Jean Jacques Grosheing and Auguste Sheurer, Logelbach, near Colmar, Haut Rhin.—Petition recorded October 15, 1864.

2666. David Laidlaw and James Robertson, Glasgow, Lanarkshire, N.B., "Improvements in exhausting, forcing, compressing, heating, cooling, and applying aeriform bodies, and in apparatus therefor."

2668. John Charlton and Henry Charlton, Strangeways, Lancashire, and John Osborn Christian, F.C.S., Manchester, Lancashire, "Certain improvements in sizing,

dressings, filling, and stiffening yarns or fabrics composed of cotton, linen, silk, wool, or other fibrous materials or paper, whereby such materials are also rendered non-inflammable."

2673. William Cormack, Little Moorfields, Middlesex, "Improvements in the distillation or destructive distillation of solid matters or semi-solid matters capable of yielding fluids or gaseous hydro-carbons or other products, such as pitcoal, boghead, or other bituminous coal or shale, peat, wood, asphalts, tallow, lard, fats, or other solid or semi-solid matters, and in the machinery or apparatus employed therein."—Petitions recorded October 28, 1864.

2678. Alexander Smith and William Smith, Glasgow, Lanarkshire, N.B., "Improvements in, and relating to, centrifugal apparatus such as is used in the manufacture of sugar."

2685. James Lee Norton, Belle Sauvage Yard, London, "Improvements in tenting, stretching, and drying fabrics, and in drying yarns, wool, or other fibrous materials and paper."—Petitions recorded October 29, 1864.

2687. John Hawkins Simpson, Kilmeena, Ireland, "Improvements in electric printing for telegraphic purposes, and in the apparatus to be used for such purposes."

2690. Joseph Solomon, Red Lion Square, Middlesex, and Alonzo Galord Grant, Nottingham, "Improvements in lamps or apparatus for burning magnesium and other metallic substances."—Petitions recorded October 31, 1864.

2695. John Frederick Brinjes, Fieldgate Street, White-chapel, Middlesex, "Improvements in apparatus for the re-burning of animal charcoal."—Petition recorded November 1, 1864.

2706. John Forster, Crow Street, and Frankfort House, Rathgan, and Harry Draper, Mary Street, and Leinster Road, Rathmines, Dublin, "Improvements in the preparation or manufacture of paper, in order to prevent the extraction or alteration of writings thereon without detection."—Petition recorded November 2, 1864.

2717. Thomas Fox, Alloa, in the county of Clackmannan, N.B., "An improved photographic process."

2723. Henry William Spencer and John Edward Ball, Willow Terrace, Upper Grange Road, Bermondsey, Surrey, "An improved method of manufacturing glue and size."—Petitions recorded November 3, 1864.

2749. Francois Henry Bickés, Rue des Messageries, Paris, France, "Improvement in apparatus for distilling."

2757. James Slack, Chorlton Works, Manchester, "Improvements in filters and filtering apparatus."—Petition recorded November 7, 1864.

2785. John Dale, Manchester, Lancashire Heinrich Caro, of the same place, and Carl Alexander Martius, Warrington, in the said county, "Improvements in obtaining colouring matters for dyeing and printing."—Petitions recorded November 9, 1864.

Notices to Proceed.

1652. William Bolivar Davis, Brooklyn, in the county of King's, New York, U.S.A., "An improved composition for preventing the fouling of ships and other vessels."—Petition recorded July 2, 1864.

1688. William Edward Newton, Chancery Lane, Middlesex, "An improved process for cleansing or clarifying impure water." A communication from Carl Johann Auguste Scheerer, Frieberg, Saxony.—Petition recorded July 7, 1864.

1705. Jean Joseph Moutié, Paris, France, "Improvements in distilling apparatus, suitable for rectifying, separating, or combining with other suitable matters, benzol, petroleum, or other more or less volatile hydrocarbons, or their derivatives, concentrating acids, treating alcoholic products, or other similar purposes."—Petition recorded July 9, 1864.

1780. Israel Swindells, Wigan, Lancashire, "Improvements in obtaining hydraulic and other cements from residuums or wastes."—Petition recorded July 15, 1864.

1813. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of, and mode of applying, explosive compounds." A communication from Alfred Nobel, Heleneborg, Stockholm, Sweden.—Petition recorded July 20, 1864.

1821. John Whitford, Liverpool, Lancashire, "Improvements in machinery or apparatus for agitating freezing mixtures, for cooling wine and other liquors or liquids, and for manufacturing ice and ice cream."—Petition recorded July 21, 1864.

1864. William Irvin, Limerick, Ireland, "An improved compound for preventing incrustations in boilers."—Petition recorded July 26, 1864.

1949. Adolph Hermann Alvin Plughaupt, Manchester, Lancashire, "Improvements in producing colour from aniline."—Petition recorded August 4, 1864.

2033. Edmund Alfred Pontifex, Shoe Lane, London, "Improvements in treating stick-lac when manufacturing shell-lac and lac dye."—A communication from Thomas Frederick Henly, Boulevard Malesherbes, Paris, France.—Petition recorded August 15, 1864.

2432. Richard Lanning, Priory Road, Kilburn, West Hampstead, Middlesex, "Improvements in making ammoniacal preparations."—Petition recorded October 4, 1864.

2583. William Buxton, Lime Tree Lodge, Rotherhithe, Surrey, "Improvements in the preparation of sheep's wool for medical purposes."—Petition recorded October 19, 1864.

2650. Bonnet Frederick Brunel, Brussels, Belgium, "Improvements in treating titanite iron sands, and in apparatus employed therein."—Petition recorded October 26, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, November 23.

Who first discovered oxygen? Priestley! cries an Englishman; Scheele! shouts a Swede; Lavoisier! screams a Frenchman. No, says M. Cap; before all these there was a modest man, one Pierre Bayen, Pharmacien-en-Chef to the French army, who in 1772, or even earlier, was experimenting with *calxes* of mercury in the hope of finding the elements of cinnabar. And among other things he did, he heated a mercurial calx (an oxide) without charcoal, and found that it gave off an elastic fluid, which he collected, measured, and weighed, and found to be heavier than atmospheric air. But here he stopped, and the name of Bayen as the discoverer of oxygen remained until now in obscurity; where it ought still to have remained, says M. Hœffer, who shows that Bayen quoted Lavoisier, and afterwards remarks that the discovery of oxygen in the latter half of the 18th century was only the hatching of an egg which had been sat upon for ages. For in November, 1489, Eck Sulzbach discovered that artificial cinnabar (red oxide of mercury) when submitted to distillation disengaged a *spirit*. He had only to catch that spirit and give it a name, and we should have had oxygen under some designation or other. Relative to this revived dispute, M. Hœffer remarks, probably with great truth, that no great discovery has come fully developed from the head of a single man, as Minerva did from the head of Vulcan.

The *Comptes-Rendus*, which you receive regularly, I may tell you, give you a very tame idea of the proceedings of our Academy, so unlike your Royal Society. It is the correspondence which is most characteristic. Everybody with an idea, and many without any ideas here, write to the Academy, just as in London they write to the *Times*. One has a notion that he can propel a ship without either sails or steam. Will the Academy appoint a commission to investigate his scheme, and recommend the Government to take it up? Another plainly asks for advice—he thinks

a navigable balloon the great want of the age; will the Academy tell him how to do it? And then the bores—M. Brachet, for example—who has sent a communication every week for the last four years, and *apropos* to whom M. Flourens lately observed that it was impossible for a man to have a good idea every week—an opinion which some people in England who listen to the same clergyman every Sunday will probably feel inclined to endorse. But, however, these things give a life and colour to the meetings of the Academy which are wanting elsewhere.

The annual Congress of German *savants*, you are no doubt aware, was held this year at Giessen. This Congress is a migratory body, like the British Association, and is, if I remember rightly, of about the same age. I was not at Giessen, but I will go to Hanover, where the Congress meets next year, if I can. According to the papers, the meeting this year was of a very enjoyable character. I have been to several meetings of the British Association, and I am bound to say that, excepting when I was on a visit to friends in the place, I found them dreadfully dull. They are all very well for the lions who get fed with flattery and other convenient food. I don't mean the Red Lions, with whom I always enjoyed myself, flourishing my tail and roaring with the rest of the caravan, and listening with more or less pleasure to the original comic songs . . . and . . . always brought with them in imitation of poor Forbes. But the rest of the evenings during the meeting, and those *conversazioni*! From all scientific *conversazioni* as means of enjoyment, — — — deliver us. Is there a soul who has not on these occasions felt some pity for a number of well-meaning men who must have come to the place with some idea of enjoying themselves, but are seen at these gatherings wandering about a crowded room with no one to speak to, and a fixed look of profoundest melancholy on their faces! Well, they do not appear to have had any *conversazioni* at Giessen, but a ball or concert every evening instead. Cannot the managers of the British Association take a hint? Surely science never was designed to make our pleasures less; and I know, at all events, some first-rate chemists in England who are excellent dancers, and some who are not bad musicians. *Definitivement*, I go to Hanover (where you will do donbt wish me), and not to Birmingham next year.

The Giessen congress was well attended by chemists. Wöhler, G. Rose, H. Kopp, Löwig, Fresenius, Strecker, Kekulé, Stas, Wurtz, and Dr. Hofmann were present. But notwithstanding and nevertheless, as some people say, the scientific results of the meeting do not appear to have been large. This may be the fault of the reporting, which has not arrived at the same degree of perfection on the Continent as it has in England. But it may be that the *savants* went to Giessen more for social enjoyment, and small blame to them if they did. To say the truth, the French reporter rather makes fun of the serious part of the Congress. There was a Schlagenweit present, he tells us—(there always used to be one or two at the British Association, with much the same story, I remember)—who informed the Congress that there were no roads among the Himalayas, and that travelling was difficult in that country, for the river-beds were stony, and horses stumbled thereon, and so on. And there was Dr. Stamm, from Berlin, who, speaking of epidemics, told his hearers that Europe was indebted for the cholera to the bad government of India by the English! I am sorry to say that no chemistry whatever is reported, and the only fact, or *on dit*, of special interest to English chemists that I can pick up is that Dr. Hofmann has already taken possession of Mitscherlich's house and laboratory, and will commence his lectures at Berlin after next Easter. It is said, however, that the doctor still intends to remove to Bonn when the great laboratory is finished. The foundation-stone of this building was laid on the 16th of September.

The Paris Photographic Society began its sittings on the 4th of this month. There was nothing of particular in-

terest brought forward. A committee reported upon some papier-maché baths and dishes, and expressed themselves strongly in favour of them. It seems that they are not at all acted upon by the chemicals made use of, are very light and portable, and, moreover, cheap to start with and not liable to breakage.

I see a mixture of nitrate of lead and silver recommended for positive prints. I do not feel certain that the process is very new, but I send it. Wöhler, it seems, noticed that when an excess of potash was added to a mixture of nitrates of lead and silver (the former in excess), a part of the oxide of lead only was dissolved, and a compound was left said to be AgO^2PbO . Potash does not act on this compound, which is, however, very sensible to light. On that observation the following process has been founded. Immerse the paper (not salted) in a solution made of—

Nitrate of lead	.	.	125 grammes
" silver	.	.	50 "
Distilled water	.	.	1000 "

Dry in the dark, and then immerse in a second bath composed of—

Water	.	.	1000 grammes
Potash	.	.	36 "

Dry again, and expose under the negative. The covered parts become lightly coloured on exposure, but hyposulphite takes out this colour. The prints may be toned with gold like the ordinary silver prints.

The Salting of Meat.

To the Editor of the CHEMICAL NEWS.

SIR,—I was much interested in hearing at the last meeting of the Chemical Society an account of the successful application of a scheme for curing meat by injecting salt brine into the entire carcase of the recently slaughtered animal. The same idea is likely to have suggested itself to many minds independently, and my friend Mr. Mackenzie long since conceived, and, I believe, carried out, the process now described by Dr. Morgan. He soon, however, encountered a practical objection in the fact that it would be necessary to impregnate the prime joints equally with the other parts which are required to be salted, and a deterioration in value was the consequence of this universal system of treatment. Under special circumstances this objection may be overruled, but the ordinary consumer would not generally be satisfied with a salted steak or sirloin, and the fatty parts would be unfit for many purposes to which suet is applied.

In connection with the salting of meat, I was witness to an incident some nine years ago, which deserves to be noticed by way of a caution. A butcher was employing—I believe from motives of economy—a zinc lined trough for containing the brine in which meat was to be salted, and this receptacle had not long been in use before symptoms of corrosion presented themselves so forcibly as to lead to the inference that the metal was being attacked and dissolved by the mixed solution of organic matters, nitre, and common salt. A sample of this meat brine having been forwarded to me for examination, I soon found that it contained a large quantity of zinc in a soluble form, and I had no difficulty in tracing the metal by boiling with sulphide of ammonium, collecting and burning the precipitate, and moistening it with solution of nitrate of cobalt, when on subsequent ignition a bright green-coloured product was obtained characteristic of the presence of zinc. On inquiry I learned that the corrosion of the trough, and not the flavour of the meat, had prompted the suspicion that a poisonous influence might be exerted.

I am, &c. JOHN SPILLER.

Maryon Road, Charlton, November 21.

[Dr. Morgan's plan is specially applicable in countries like South America, in which the prime joints are not required for home use.]

New Minerals from Cornwall.

To the Editor of the CHEMICAL NEWS.

SIR,—Would you kindly insert a note in your next number to state that I some time ago discovered two new minerals associated with Langite? One is a green mineral, which I call Waringtonite, the other a whitish-blue one, which I have named Lyellite. As M. Pisani, in Paris, appears to think it not unfair to attempt to forestall me in my descriptions of this Cornish group of minerals, I am obliged to ask you this favour.

I exhibited Waringtonite and Lyellite at the Geological Society in July. But no opportunity of naming them or describing them was then afforded me, though their analysis was made in June: and, in truth, I had never dreamt that any gentleman in England or abroad would have refused to me the courtesy generally paid to every man of science in announcing a discovery—that, namely, of leaving to him the description of what he has discovered. My having no laboratory in the British Museum compelled me to go elsewhere to make the analyses, the publication of which has been delayed that I might confirm two or three determinations about the exact precision of which I felt uncertain. An absence in Russia on public business for two months, and a consequent pressure of other duties, compelled me to postpone this, and has caused the delay in my publishing what I never had any fear of being forestalled in.

My investigation of these minerals, crystallographically and chemically, will be immediately submitted to the Royal Society.

I am, &c.

NEVIL STORY MASKELYNE.

British Museum, November 19.

Analysis of Cotton Seed.

To the Editor of the CHEMICAL NEWS.

SIR,—In No. 258 I find a short notice on cotton seed oil. I received a few days ago a fair average commercial sample of Egyptian cotton seed imported from Alexandria, which I analysed, the result being, in 100 parts of the finely pulverised seeds, free from adherent cotton, the following:—

Moisture driven off at 212°	9.520
Oil extracted by boiling ether	20.880
Gum, mucilage, &c., soluble in boiling water	14.000
Albuminous compounds	26.640
Woody fibre	25.185
Ash	3.775
	<hr/>
	100.000

The seed contains no starch of the kind which yields a blue colour with iodine.

I have a sample also of the crude oil, upon which I am making some experiments; its darkish brown-red colour, somewhat resembling the colour of bromine, appears, as far as I have yet been able to ascertain, due to a peculiar principle dispersed through the seeds in very small quantity, soluble in ether, and contained in peculiar cells. It would appear that the peculiar reddish-brown colour is developed on coming in contact with the oxygen of the air. The crude oil is freely soluble in ether, which also assumes the colour.

I am, &c.,

DR. A. ADRIANI.

Sugar Refining.

To the Editor of the CHEMICAL NEWS.

SIR,—I request you to insert in your next issue the following reply to Dr. Schwarz, condensed by me from what I wrote about three months ago:—

1. Dr. Schwarz does not give on page 92, vol. x. of your paper a sufficiently clear and explicit description of his mode of working and the apparatus therein employed.

2. Dr. Schwarz departs from the rule, *qui bene distinguit bene docet*, when he says in the beginning of his letter, page 131, vol. x., “the result arrived at is totally at variance with the experience of Mr. Dumas, who has adopted it for the estimation of sugar;” every one acquainted with chemistry knows, that estimation means the quantitative determination of a substance. And so far from the use of a mixture of alcohol and acetic acid being something new for this very purpose, I can assure Dr. Schwarz that it was in pretty general use for at least so far back as 1848, and no doubt but I could point out to Dr. Schwarz that Dumas cannot but have been aware of this.

3. The use of a mixture of alcohol and acetic acid, however fit it may be to estimate sugar, has nothing whatever to do with the application on the large scale of a mixture of the same substances, or as Dr. Schwarz prefers hydrochloric acid, to purify raw sugar from molasses; it is not easy to see how, as Dr. Schwarz asserts, hydrochloric acid, certainly a less expensive article than acetic acid, should produce more readily the sugar crystals. Dr. Schwarz certainly does not mean to infer that hydrochloric acid should in reality produce sugar crystals, if the latter had not been, previous to the use of his mixture, ready formed, by the sugar-containing liquor having been boiled down to the point of crystallisation.

4. Dr. Schwarz, in the description of his process (page 92, vol. x.), does not at all say what vessels he employs, while it is further (see page 92, column 2, line 16 from the top) also somewhat left in *vago* as to what means are to be resorted to to recover the alcohol.

5. As to Dr. Schwarz’s objections to the baryta process, I know that in Belgium and in France it has been found to answer; and as regards the refuse, I remind Dr. Schwarz of the existence in both these countries of the strict regulations laid down by the proper authorities for the promotion of public health and safety, under the *Loi Organique Concernant les Etablissements Dangereux et Insalubres*, made in 1810.

6. As regards Dr. Schwarz’s refutation of the objection I took to the use of acids in its effects upon the machinery and plant, I have to remind Dr. Schwarz that just in consequence of the bad effects of acids into which oils and fats are gradually converted, the greatest possible care is required to select for lubricating purposes such materials as are least apt to give rise to corrosion. Dr. Schwarz says that only organic acid is present; pray are acetic, tartaric, and other organic acids without effect upon metals like as brass, copper, iron, &c.? I have repeated the experiment mentioned by Dr. Schwarz, and left clean, pure iron wire for twenty-four hours in a mixture of one fluid ounce of strong alcohol and ten drops of pure hydrochloric acid, and found that the iron was very appreciably acted upon.

7. I did, in speaking of the use of a solution of pure refined sugar to free raw sugar from molasses, not thereby mean that this is actually a useful practical method; I only said it can be done. Dr. Schwarz, in rebuking me, forgets that *a posse ad esse non valet conclusio*. I also very well know that water may in small quantity serve that purpose, but, of course, as rightly observed by Dr. Schwarz, its use is accompanied with loss of sugar.

8. I have to remind that sugar, however pure, as obtained by the application of centrifugal machines, is not exactly the form in which that necessary of life is most appreciated and liked by the consumers. If Dr. Schwarz intends his process only to serve for obtaining a better raw sugar, then I think that, by due care in the selection of the cane or beet-root, and by applying the best mechanical means to express the juice, and the avoidance of all such influences as are known to convert a larger or smaller proportion of crystallisable sugar into non-crystallisable, and the more general introduction of vacuum pans in the manufactories of raw cane and beet-root sugar, the pro-

portion of molasses produced may be to a great extent so reduced as not to require the introduction of new and perhaps complicate apparatus, and that thus also may be avoided the use of alcohol, which, moreover, in almost all countries would meet with a difficulty in the admission of its use on account of the existing excise regulations upon spirits. As regards the use of acid, it will require on the part of the workmen more care to take and apply it (the acid) in the precise proportion than can possibly always be expected to be bestowed by working men upon such an operation. Hydrochloric acid, moreover, is frequently contaminated with impurities, among which may be arsenic, and its use also may, on that account, be taken objection to.

I am, &c.

Dr. A. ADRIANI.

MISCELLANEOUS.

The Pharmacy Bill.—A deputation of the Council of the Pharmaceutical Society of Great Britain, consisting of Mr. Sandford (President), Mr. Hills (Vice-President), Mr. Daniel Bell Hanbury (Treasurer), Mr. Squire, Mr. Morson, Mr. Waugh, Mr. Orridge, Dr. Edwards, Mr. Flux (Solicitor), and Mr. Brembridge (Secretary), had an interview with the Right Hon. Sir George Grey at the Home Office on Tuesday last, on the subject of a proposed bill for regulating the qualifications of chemists and druggists.

Illumination of Street Names.—Several attempts have been made to render the titles of the streets of Paris as visible at night as in the day time, and at last apparently with success. The labels in the neighbourhood of the Hôtel de Ville are now lighted up in the following manner:—The frame in which the letters are set is made in the form of a rectangular trough, the upper and lower portions being pierced with holes to allow of proper ventilation, and within this is a gas-pipe with a number of small jets, according to the length of the tablet, and, consequently, the number of transparent letters to be illuminated. The upper part of the box, or trough, opens to allow of lighting and repairs, and is closed by a counterpoise concealed in the stonework of the walls. We are not informed yet of the cost of this very useful arrangement.

Revived Corks.—The attention of the French public has been called by M. Stanislaus Martin to the employment of refuse corks as dangerous to public health. It is the custom of the Paris scavengers to collect those which are brought down by the sewers, and sell them to persons who make it their business to revive them. If the corks are of unsightly shape they are re-cut; while, if containing holes, these are filled up with mastic, and then smeared with a powder to give them a proper colour. Such corks used only to be employed by the ink and blacking makers, but their low price (5s. 6d. per 1000) has of late induced retailers of bottled beverages to purchase them. M. Martin asks if there be not ground for alarm lest some of these corks may have been formerly used to stop bottles containing poisonous substances; for although a good cork is not permeable, a bad one, full of holes, may readily become the receptacle of particles of verdigris, carbonate of lead, arsenic, or an infinity of other poisonous substances, which may be more or less soluble in water, wine, beer, cider, vinegar, milk, or oil. The *Medical Times* expresses a hope that these revived corks may never give rise to juridical errors, causing the innocent to be declared guilty.

The Patent Laws.—We learn that the following will be the most important recommendations to be made by the Royal Commission which has been appointed to examine and report upon the Patent Laws:—"1st. That the present system of obtaining and paying for letters patent ought to be maintained; but that patent fees should

not be made to contribute to the general expenditure of the State until every reasonable requirement of the Patent Office has been satisfied. 2nd. That no patent be granted if it be found, after examination, that there has been any previous documental publication of the invention; but that no investigation be entered into concerning its merits. 3rd. That one of the judges should sit for the trial of patent cases exclusively; that he should be assisted by scientific assessors; should sit without a jury, unless the parties to the suit or action desire a jury; and, when sitting without a jury, that he should decide questions of fact as well as law. 4th. That the granting of licences to use patented inventions ought not to be made compulsory. 5th. That patents ought not to be granted to importers of foreign inventions. 6th. That no patent should be extended beyond the original term of fourteen years. 7th. That the Crown should be empowered to use patented inventions without having obtained the consent of the patentee, and should pay him for such use a sum to be fixed by the Treasury." These are very slight alterations, but quite as much as we expected from the Commission.

Treating Poor Lead Ores by Hydrochloric Acid.—M. H. C. Lampadius (a name classical in the annals of metallurgy), engineer of the mines at Vüsek, states that the ores of those mines, according to their richness and the specific gravity of the acid, are treated with the proper quantity of hydrochloric acid to form chloride of lead. The transformation into chloride of lead operates completely when the ores have been well prepared. This chloride is introduced into double-bottomed vats, and sprinkled with a sufficient quantity of boiling water. The solution of chloride of lead thus obtained is drawn off into reservoirs, and left to settle. The mother waters, which contain only a very minute quantity of chloride, are reserved for a new solution. The chloride is then treated with a minute quantity of pure water by metallic zinc. There is thus formed chloride of zinc, and metallic lead is separated in a dense and spongy mass, which after being washed may be melted in an ordinary furnace. The solution of the chloride of zinc is first freed from any iron that it may contain by a little chloride of lime, and the zinc is then precipitated in the form of oxide of zinc by means of calcined chalk. It may thus be utilised for zinc white, or it may be reduced and used again. As hydrochloric acid is of a moderate price, and as the expense of the zinc is covered by the sale of zinc white, this process ought to be advantageous in the treatment of ores too poor to be treated by fusion.—*Mining and Smelting Magazine*.

Errata.—In the table given in Mr. Collier's paper, page 182, for the sign of addition + in all cases read the sign of multiplication ×.

ANSWERS TO CORRESPONDENTS.

* * In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

* * All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements and Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

R. Warrington, jun.—Received with thanks.

W. M.—The question was answered in No. 257, p. 228, under the initials "W. C. C."

M. A. B.—With every wish to oblige, we cannot find space for the communication, which, besides, contains statements which are open to contradiction.

Books Received.—"A Manual of Materia Medica and Therapeutics," by J. F. Royle, M.D., and F. W. Headland, M.D.; "Report of Experiments on the Growth of Wheat for Twenty Years in Succession on the same Land," by J. B. Lawes and J. H. Gilbert, Ph.D.; "On the Chemistry of the Feeding of Animals for the Production of Meat and Manure," by J. B. Lawes, F.R.S.; "A Treatise on Smoky Chimneys," by Frederick Edwards, Jun.

SCIENTIFIC AND ANALYTICAL
CHEMISTRY.

Estimation of Phosphoric Acid,
by M. TH. SCHLÆSING.

THE estimation of phosphoric acid has been made the object of very numerous researches, and many methods have been proposed by which to effect it; nevertheless, chemists are, in certain cases, embarrassed in determining this acid. I have tried whether separation by volatilisation, which often gives such exact results, would be more successful than analysis by precipitation, when applied to phosphoric acid, and I endeavoured to extract phosphorus from the phosphates, by bringing them in contact with a fixed acid silicie, and a reducing body at a high temperature.

At present I have restricted myself to earthy phosphates, and have not investigated the alkaline phosphates, which, however, are amenable to the same method, especially M. H. Sainte-Claire Deville's process; nor have I yet studied the metallic phosphates—such as iron and nickel, which retain phosphate at a white heat.

By heating to whiteness a mixture of carbon, silica, and phosphate of lime, magnesia or alumina, the whole of the phosphorus is not extracted, owing to the unavoidable imperfection in the mixture. To avoid this drawback I replaced the carbon by a current of reducing gas, and succeeded in intimately mixing the silica and phosphate by dissolving the latter in very little nitric acid, and by adding silica to the hot liquid until it refused to absorb more. The silica was obtained by attacking silicates; by drying on a sand bath, and heating to redness, I obtained a mixture, which did not adhere to platinum, and which could be transferred when necessary with no loss whatever.

As phosphorus attacks platinum, and as it is necessary to preserve the silicate in its integrity, which could not consequently be placed in contact with porcelain, I transferred the mixture of phosphate and silica to a charcoal boat, to introduce it afterwards into a tube of Bayeux porcelain. I make this kind of boat by pouring a paste of burnt sugar and syrup through a tube made of blotting paper; after a few minutes I remove the excess affixed to the paper; next dry and then make red hot. I then cut the tube into two half cylinders, and close the ends with a paste more solid than the first. If this process comes into general use, boats of charcoal will be manufactured. The tube may be heated in various ways, but I prefer gas, as then it is not necessary to preserve the tube from contact with the combustible, and the same tube serves for several operations. Four strong blow pipes should be arranged, vertically, at equal distances, within a space of 8 centimetres, and projecting their flames on the porcelain tube, whose heated part, about 10 centimetres, is surrounded by platinum foil, and placed in a muffle composed simply of a few refractory bricks. In seven or eight minutes the tube reaches white heat.

I had some difficulty in finding a suitable reducing gas. Sulphide of carbon forms complex products, sulphide of silicon among others; hydrocarbons deposit carbon on the sides of the tube, which destroys the covering; it is the same with common gas; at last I tried carbonic oxide, which, contrary to my expectations, succeeded perfectly. Though already oxygenated, this compound is a sufficient reducer even for phosphoric acid; it must be dry, as phosphorus decomposes water at red heat, and should

retain little carbonic acid, which might interfere with its reducing power.

By these means I have succeeded in completely expelling phosphoric acid from earthy phosphates. I give two experiments:—

I.		Grammes.
Phosphoric acid	.	0.062
Magnesia	.	0.112
Silica	.	0.472
Weight before heating		0.646
After 0.582.5		Loss 0.063.5

The silicate obtained is an uncohesive powder attackable by digesting in hot nitric acid.

A previous experiment on phosphate of alumina having shown that in the absence of another base this salt is but imperfectly reduced, I repeated the experiment after introducing lime.

II.		Grammes.
Phosphoric acid	.	0.124
Alumina	.	0.072
Lime	.	0.112
Silica	.	0.733.5
Weight before heating		1.041.5
After 0.918.5		Loss 0.123

The silicate produced was agglomerated in the form of a porous scoria.

In these two experiments the heating lasted half an hour; each of them consumed one and a-half litres of oxide of carbon.

Two favouring circumstances remain to be mentioned: when phosphates are free from alumina, the silicates produced abandon their bases to hot nitric acid, although they contain some excess of silica, and have undergone a high temperature. When phosphates contain alumina the silicates are again destroyed by digestion with potash at 150° to 200°; thus, in both cases, the bases can be easily determined after the removal of the phosphoric acid.

Hitherto the acid has been estimated only by difference, but when the phosphorus has been set at liberty it may be collected and estimated directly, giving to this method all the requisite certainty. The porcelain tube may be bound with a thin silver tube containing metallic copper and heated to dull red. The silver will not be attacked, and the copper will absorb the whole of the phosphorus, the quantity of which will be indicated by the increase of weight of the silver tube. But we do not in this way get a compound so well defined as might be desired: hence I prefer transforming the phosphorus into a phosphate which should realise this condition, and have chosen that of silver as being the best characterised of the phosphates.

I direct the gaseous current from a porcelain tube into a bulbed tube containing a solution of nitrate of silver. The whole of the phosphorus condenses in it, forming a black phosphide of silver, and some phosphate dissolved by the displaced nitric acid. It is essential that the bulbed tube should be heated in a water bath towards 80° or 90°; for the true combination of carbonic oxide and phosphorus mentioned in Berzelius' treatise abandons all its phosphorus only with the aid of heat. The argentic liquid is decanted into a platinum capsule and evaporated; then on the residue I pour the hot nitric acid with which I had washed the bulbs; all the phosphorus is thus converted into phosphate: I evaporate to dryness, heat until the excess of nitrate of silver is

fused, and no perceptible acid vapours are disengaged. Under these conditions, the phosphoric acid takes up and unites exactly with the three equivalents of silver, constituting the tribasic phosphate; the resulting salt is washed by simple decantation on a filter, the particles fallen on the filter are washed into the platinum capsule by a jet of water from a wash bottle, and the salt is dry and weighed.

Phosphate of silver is found to possess two advantages in analytical processes: its equivalent is very heavy, and its composition is rapidly verified by the estimation of silver. It condenses a little phosphorus in the porcelain tube, but it is red phosphorus, emitting no vapour when cold, and which may be recovered without loss by rinsing out the tube with nitrate of silver and then with nitric acid: these washings are added to the contents of the bulbs.

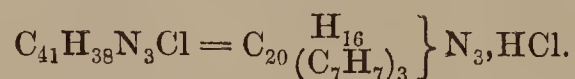
The production of tribasic phosphate of silver in presence of fused nitrate of silver is not limited to the instance I have just given; phosphates of ammonia, potash, and soda behave like pure phosphoric acid. This, then, is a very sure method of estimating phosphoric by phosphate of silver, either when alone or accompanied by an alkali, but in the absence of any earthy or metallic base.

I propose founding on the above a process for estimating the phosphoric acid in manures and earths.—*Comptes Rendus*, lix., 384.

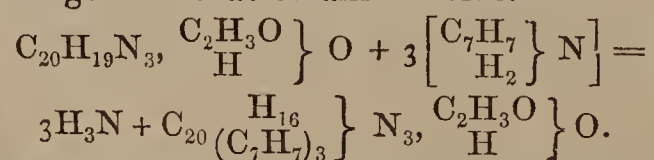
*Researches on the Colouring Matters derived from Coal-tar—No. IV. Phenyltolylamine—by A. W. HOFMANN, LL.D., F.R.S.**

THE discovery of diphenylamine among the products of decomposition furnished by the destructive distillation of aniline blue (triphenylic rosaniline) naturally suggested the investigation of analogously constituted bodies in a similar direction. My attention has in the first place been directed to the study of a compound which, from its mode of formation, ought to be designated as toluidine blue.

When a salt of rosaniline (the acetate, for instance) is heated with double its weight of toluidine, phenomena present themselves which are similar to those observed in the analogous experiment with aniline. In the course of a few hours the rosaniline passes through all the different shades of violet, and is ultimately converted into a dark lustrous mass, which dissolves in alcohol with a deep indigo blue colour. This substance is the acetate of tritolylrosaniline. By treatment with alcoholic ammonia, and subsequently addition of water to the solution, the free base is easily obtained, from which the several salts may be prepared by the usual processes. I have examined only one of these salts, viz., the hydrochlorate. Repeatedly crystallised from boiling alcohol, this salt is obtained in small blue crystals insoluble in water, which at 100° C. contain



The formation of toluidine blue is thus seen to be perfectly analogous to that of aniline blue.



I have not examined in detail the properties of this new series of colouring matters. Generally speaking,

they are more soluble than the corresponding phenyl compounds, and therefore less easily obtained in a state of purity.

When one of these salts (the acetate, for instance) is submitted to dry distillation, water and acetic acid are evolved in the first place; then follow oily products, which, as the temperature rises, become more and more viscid, and ultimately solidify into crystalline masses, ammonia being abundantly evolved during the latter stages of the process. Unless the operation has been carried out on rather a large scale a comparatively small amount of a light porous charcoal remains in the retort. The oily distillate contains several bases. Those boiling at a low temperature are almost exclusively aniline and a little toluidine. The principal portion of the products boiling at a higher temperature is a beautifully crystallised base which is easily purified. By pouring cold spirit upon the interwoven crystals, a brown mother liquor containing other bases is readily separated; the residuary substance has only to be crystallised from boiling alcohol in order to procure a compound of perfect purity.

The chemical deportment of the new substance is very similar to that of diphenylamine. Like the latter it unites with acids, forming salts of very little stability, splitting up into their constituents under the influence of water, of heat, and even by mere exposure *in vacuo*. In contact with nitric acid the crystals at once assume a blue coloration, with an admixture of green, but nevertheless so similar to the analogous colour reaction of diphenylamine that by this test alone the two substances could not possibly be distinguished. The two bases differ, however, essentially in their solubility, their fusing and boiling points, and lastly in their composition. The new base is far less soluble in alcohol than diphenylamine; it fuses only at 87° C., while the fusing point of diphenylamine is 45° C.; the boiling point of the new base is 334.5° C. (corr.), at which temperature it distils without any decomposition, while diphenylamine boils at 310° (corr.).

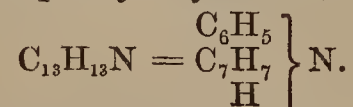
The results of analysis lead to the formula



A hydrochlorate, crystallising in little plates, and obtained by the addition of concentrated hydrochloric acid to an alcoholic solution of the base, when dried over lime was found to contain



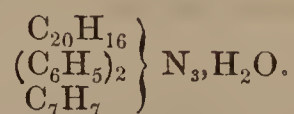
Formation and chemical deportment characterise the new base as the mixed secondary monamine of the phenyl and tolyl series, as phenyltolylamine,



In consequence of the simultaneous existence in the molecule of the new base of the radicals phenyl and tolyl, its deportment under the influence of dehydrogenating agents became of considerable interest; and, indeed, having recognised the nature of the compound, my first experiment consisted in submitting it to the action of corrosive sublimate. Both substances unite to form a dark brown mass, which, after having been heated, dissolves in alcohol with a magnificent violet-blue colour. The compound thus produced exhibits the behaviour of the colouring matters generated from rosaniline by substitution. Owing to the peculiar properties of this class of substances, it would be difficult to prepare the new compound in sufficient quantity for a detailed examination; but, judging from its mode of

* Abstract from *Proceedings of Royal Society*, vol. xiii.

generation, it will probably be found to be tolydiphenyl-rosaniline,

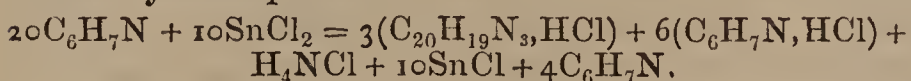


It scarcely requires to be mentioned that it is not necessary to prepare the pure toluidine blue for the purpose of obtaining phenyltolylamine. It suffices to maintain for some hours a solution of ordinary but dried acetate of rosaniline in its double weight of toluidine, in a flask provided with an upright condensing tube, at a boiling temperature, and to submit the violet-blue mass produced to destructive distillation over a naked burner. The distillate is treated with hydrochloric acid, and subsequently with water, when aniline and toluidine, together with several other basic substances accompanying the phenyltolylamine, remain as hydrochlorates in solution. The oily layer which separates generally solidifies, or may be purified by rectification. The resulting crystals are crystallised from alcohol.

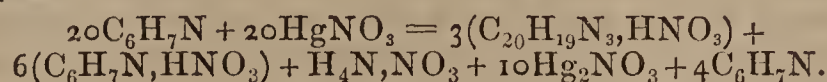
The same method is also adapted for the preparation of diphenylamine, aniline being substituted for toluidine.

If I have bestowed upon diphenylamine and phenyltolylamine rather more attention than these substances at the first glance appear to claim, I have done so in the hope of gaining additional data for the investigation of the remarkable colouring matters from which these bases are derived. Both constitution and mode of formation of these colouring matters are still involved in darkness. Theory, as it often happens, has not kept pace with practice. The anticipation I expressed in a former note, that the study of the behaviour of the colouring matters under the influence of chemical agents might disclose their true nature has only very partially been realised. Up to the present moment chemists have not succeeded in giving a satisfactory account either of the atomic construction of these compounds or of the mechanism of their formation, and it would therefore scarcely be worth while to return to this question before its definite solution unless the publication of erroneous statements by M. Schiff had threatened to divert the researches of chemists from this subject.

According to M. Schiff,† the transformation of aniline into aniline red by means of stannic chloride is represented by the equation—



The formation by means of mercuric nitrate‡ by the equation—



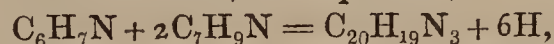
The latter process is accomplished at as low a temperature as 80° C., and, according to M. Schiff, is so elegant that he was enabled to make quantitative experiments. "Within a few hundredths," he says, "we have obtained the requisite quantities of the sought-for materials."

M. Schiff's equations are not conspicuous for elegance and simplicity, but they are absolutely inadmissible for other reasons. These equations utterly ignore the very essence of the process. I have pointed out, some time ago, that the formation of rosaniline involves the presence of both aniline and toluidine. Pure aniline furnishes no rosaniline, nor can this body be procured from pure toluidine. This fact I have since further established by many varied experiments, both on the small and on

the large scale. The formation of rosaniline thus becomes the means of ascertaining rapidly the presence of toluidine. The amount of the latter in crude aniline § may become so minute that its presence can no longer be traced by distillation or by conversion into oxalates. It may be recognised, however, with the utmost facility by submitting the mixture to the action of either corrosive sublimate or arsenic acid; on application of a gentle heat the crimson colour is immediately produced.

In the equations proposed by M. Schiff there figures, moreover, ammonia as an essential term. The existence of ammoniacal salts in the crude rosaniline was pointed out some time ago by Prof. Bolley. But this ammonia (which, as I have satisfied myself, is scarcely ever absent) is, according to my opinion, not an essential product of the reaction that gives rise to the formation of aniline red. I have established by special and careful experiments that appropriate treatment of a mixture of aniline and toluidine with chloride of mercury at a moderate temperature is capable of producing very considerable quantities of rosaniline without elimination of more than a trace of ammonia. The ammonia generally observed belongs to a different phase of the reaction, being more especially due to the almost invariable production of a small quantity of aniline blue.

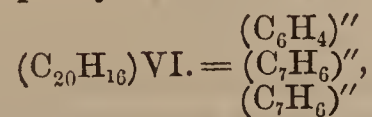
If we wished, even now, to represent in formulæ the relation between rosaniline and the substances which give rise to its formation, the equation,



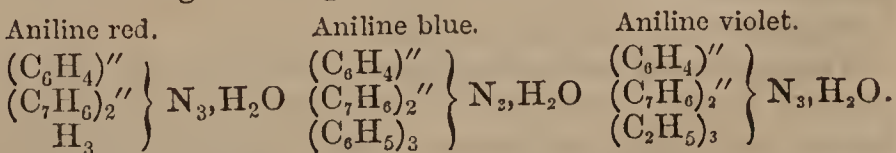
might be looked upon as an expression closely approaching truth. The hydrogen figuring in this equation is eliminated in the form of water, hydrochloric, hydrobromic, hydriodic acids, &c.

But even this equation gives no account of the mechanism of this remarkable process; indeed, we cannot hope for the solution of this chemical problem before we shall have succeeded in splitting up the molecule of rosaniline into the atomic groups which enter into its composition. It is true its transformation into aniline or toluidine blue, as well as into the several violets which are generated by the substitution of alcohol radicals, prove even now that the rosaniline molecule still contains three atoms of typical hydrogen, and hence that the complex atom $\text{C}_{20}\text{H}_{16}$ functions in this triamine with the value of six atoms of hydrogen; but this, indeed, is the limit of the experimental evidence as yet obtained.

With regard to the number and nature of the simpler radicals into which the carbon and hydrogen atoms of the complex atom $\text{C}_{20}\text{H}_{16}$ are grouped, we can only speculate. Derived from the radicals phenyl, C_6H_5 , and tolyl, C_7H_7 , under the influence of dehydrogenating agents, this complex atom may possibly contain the bivalent radicals phenylene, C_6H_4 , and tolylene, C_7H_6 —



when the molecular construction of the three colouring matters might be represented by the formulæ—



§ Aniline obtained by distillation with potash from certain varieties of indigo is apt when treated with corrosive sublimate to furnish traces of rosaniline. I infer from this result that aniline thus produced contains a small proportion of toluidine. The formation of this substance from indigo would be as readily intelligible as the conversion under certain conditions of indigo into salicylic acid, a fact established by Cahour's observations. Aniline prepared from crystallised isatin does not yield a trace of rosaniline.

† *Comptes Rendus*, vol. lvi., p. 271.

‡ *Ibid.*, p. 545.

We must not, however, forget that this is simply an hypothesis, and that the elements in the complex atom $C_{20}H_{16}$ may be associated in a great variety of other groups. An interesting observation quite recently made by Dr. Hugo Müller, and communicated to me by my friend while these pages are passing through the press, may possibly assist in further elucidating the nature of this class of bodies. Dr. Müller has found that rosaniline and its coloured derivatives are instantaneously decolorised by cyanide of potassium, a series of splendidly crystallised, perfectly colourless bases being produced. The composition of these bodies, which will probably be found analogous to a substance similarly obtained from harmaline by Fritzsche, remains to be established.

On Thallic Alcohols, by M. LAMY.

AMONG the various compounds of thallium, I have already mentioned the existence of a liquid possessed of very curious physical properties (*Comptes Rendus*, lv., 837). This liquid, which I called "thallic alcohol," on account of the similarity of composition with potassic alcohol which I have supposed it to possess, was remarkable for its density, which was three and a-half times greater than that of water, whilst, according to a superficial examination, it equalled in refracting power sulphide of carbon.

I have since studied more carefully this curious compound, and found it to be not only heavier than all known liquid compounds, but in its power of refraction and dispersion greater also.

In the hope of obtaining a liquid still more extraordinary with respect to its optical properties, I was led to investigate a homologous compound produced by fusel oil or amylic alcohol, the molecule of which is about twice as heavy as that of ethylic or ordinary alcohol. I obtained, in fact, a compound which may be called amyl-thallic alcohol, but the density of which, as also the refraction, though very considerable, are not relatively so great as I had supposed them to be.

Finally I endeavoured to produce methylthallic alcohol with wood spirit.

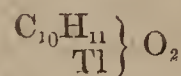
The following are the results of my observations on the three alcohols, ethyl-thallic, amyl-thallic, and methyl-thallic:—

I will only give an abstract of the principal properties and the method of preparation of these three compounds.

Ethyl-thallic alcohol—



and amyl-thallic—



are both liquid at the ordinary temperature. Prepared with the subjoined precautions their respective densities are at the temperature 0° 3.550; 2.465, and their indices of refraction, at 20° , 1.678 and 1.572; for the ray D in the spectrum.

Methyl-thallic alcohol is solid.

The indices of refraction corresponding to the rays B and H of ethyl-thallic alcohol are 1.661 and 1.759, the difference of which, which measures the dispersive power, is 0.098; while the difference of the corresponding indices of sulphide of carbon (1.614 and 1.693) taken at the same temperature is only 0.079, or 0.019 less than the preceding.

Ethyl-thallic alcohol is, then, the heaviest, the most refractive, and at the same time the most dispersive of light of all known liquids.

The same liquid crystallises about 3° below zero, while amyl-thallic alcohol will not crystallise at 20° below zero.

Neither of them can be boiled without decomposing; when distilled they give, among other remarkable products, pure hydrogen, alcohol, the salt of an oxygenated acid corresponding to this alcohol, and an abundant residue of metallic thallium.

The three compounds burn in the air with a flame more or less bright and green, leaving as residues black oxide, with small buttons of the metal. All three are soluble in the corresponding alcohol and in ordinary ether; when the ether is pure and anhydrous, the ethereal solution remains limpid. But if the ether is more or less aqueous, or if it has been for some time in contact with the air, it gives a yellowish solution, which gradually deposits radiating crystals of hydrated protoxide of thallium, becoming brown under the oxidising action of aerated ether. This reaction is extremely sensitive.

Chloroform also dissolves thallic alcohols; the two liquids more easily than the solid. But soon the solution which was limpid becomes cloudy, yellow, and deepening in colour, deposits a relatively considerable quantity of crystallised protochloride thallium. Formic acid is produced at the same time, and also a photogenic matter very sensible to the action of light, which communicates its brown colour to the chloride.

Thallic alcohols are decomposed more or less easily by water or atmospheric moisture. Hydrated oxide of thallium is set at liberty, and the corresponding alcohol regenerated. They are also decomposed by acids; nevertheless, carbonic acid seems to form a solid, definite compound.

Sulphide of carbon acts strongly upon them, the compounds produced varying with the relative quantity of the elements placed in contact.

Ethyl-thallic alcohol is prepared as follows:—Put a large excess of absolute alcohol in a large flat-bottomed vessel, under the receiver of an air-pump, and above the liquid very thin plates of thallium, supported by wire-gauze. Form a vacuum in the receiver, to remove, with the air, the moisture and the carbonic acid contained in it, and finally put the receiver in communication with a bag of oxygen, by means of tubes filled with sulphuric acid and pumice, and another with potash.

At 20 or 25° the thallium is rapidly transformed into a heavy oil, which falls through the alcohol to the bottom of the vessel. In this way, without touching the apparatus, a hundred grammes of heavy oil are easily produced in twenty-four hours.

Amyl-thallic alcohol may be prepared in the same way with amylic alcohol; but the slowness of the action makes the following process preferable:—Mix, in exactly equal proportions, amylic and ethyl-thallic alcohol, and distil at a temperature which should not exceed 140° .

But these methods do not succeed with methyl-thallic alcohol, because this compound covering the leaves of thallium with a solid crust prevents the action of the oxidising vapours. It is, however, very easily obtained in the form of a granulated white precipitate by simply pouring an excess of methylic alcohol on one of the two liquid thallic alcohols.

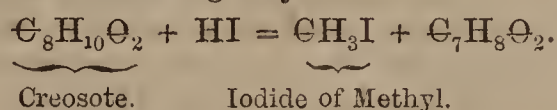
From the existence of the three compounds formed by the best known thallic alcohols, it may naturally be inferred that analogous compounds may be formed with the very numerous alcohols now known. — *Comptes Rendus*, lix., 780.

On the Chemical Constitution of Reichenbach's Creosote,
by HUGO MULLER, Ph.D.*

ON heating pure creosote boiling (in hydrogen) at 219° C. with hydriodic acid, the author found that iodide of methyl distilled over, and a residue was left in the retort which readily dissolved in water, with the exception of a small quantity of heavy brown oil, which contained unaltered creosote. The aqueous solution was mixed with a large quantity of water, and partly saturated with carbonate of barium, the clear liquid filtered off and precipitated with acetate of lead, the white precipitate well washed and decomposed with sulphuretted hydrogen. The sulphide of lead having been filtered off, the aqueous solution was carefully evaporated, by which a thick heavy liquid was obtained. The reactions of this liquid so closely resembled those of pyrocatechine or oxyphenic acid, that the author would be inclined to consider it identical with this substance if it were not for the apparent impossibility of obtaining it in a crystalline form.

The author has not yet determined the composition of the liquid substance, but so far as he has investigated its chemical nature, he thinks it more than probable that the substance bears the closest analogy to oxyphenic acid ($\text{C}_6\text{H}_6\text{O}_2$), and is in all probability its homologue.

The described decomposition of creosote may be expressed in the following way:—



According to which creosote may be regarded as methylated oxytolyllic acid or oxycressylic acid. This view is supported by the general properties of creosote, and the fact that a lower homologue of creosote and free oxyphenic acid exist among the products of the distillation of wood.

TECHNICAL CHEMISTRY.

On the Occurrence of the Diamond in Brazil,
by MM. HENSSE and CLARAZ.†

IN the Brazilian plains which constitute the diamond region, the granitic gneiss which forms the coast alternates with quartzite and crystalline schists. Of these rocks the most important is the quartzite, to which Eschwege has given the name *itacolumite*. It is a sort of sandstone, granular and friable, often contains talc, chlorite, and mica, and generally possesses a schistose structure. It is sometimes traversed by veins of quartz containing pyrophyllite similar to that found in the Ural mountains.

Itacolumite is no doubt a metamorphic rock, which was originally deposited by the water; it contains no fossil remains, but shows distinct traces of waves.

The metamorphic schist presents very varied characters. It contains quartz, which is sometimes associated with chlorite and talc, and sometimes with mica; in the last case it passes into mica-schist. Hornblende is never found in the varieties of the schist which are worked for diamonds. Sometimes the schistose character of the rock is lost, and it then contains more or less oxide of iron.

Very often the metamorphic schist passes quite imperceptibly into argillaceous schist containing talc, mica, and disthene; and also just as imperceptibly into ita-

columite. Besides the minerals before mentioned, the metamorphic schist sometimes encloses limestone, schistose, oligist, and *itabirite*.

Itabirite is simply a variety of schistose oligist which is accompanied by quartz and mica. It sometimes forms thick and extensive beds, which might be worked for iron. When in a pulverulent condition it is known by the name of *jacotinga*, and the valuable English mine of Gongo Socco is worked in a deep bed of this mineral.

Limestone is also found in deep beds having numerous caverns which are rich in bones and saltpetre.

Itacolumite and the metamorphic schist are generally found in alternate layers. The direction of these beds follows the general direction of the mountains, which is nearly always north and south; they dip towards the east. They have been dislocated, so that they form abrupt and bare rocks, which in the case of itacolumite are traversed by numerous rounded channels. Both rocks are very subject to decomposition. In itacolumite, which is essentially quartzose, the decomposition is specially characterised by a *fissuration* of the rock, which falls to dust. In the metamorphic schist, the chemical and physical properties are modified by the hydrated oxide of iron set at liberty, which ordinarily furnishes a cement for new rocks. When the rock decomposed is very rich in iron, that in the neighbourhood of itabirite, for example, it sometimes forms a breccia, which is generally composed of angular fragments of more or less altered schist, cemented together by the hydrated oxide of iron.

The metamorphic schist sometimes decomposes to a great depth, changing to an earthy mass, which in the rainy season is converted into mud. The depth of the decomposition is somewhat astonishing in the tropics, since it is not assisted by the action of snow and ice. It is no doubt caused by the violence and frequency of tropical rains, and the solvent action of the water increased by the temperature. The water also, it must be remarked, contains nitric acid, in consequence of the storms which follow with great regularity during several months of the year.

Among the products of the decomposition of itacolumite and the metamorphic schist are found many rare minerals—the diamond, euclase, topaz, chrysolite, cymophane, transparent andalusite, tourmalines, amethysts, &c.

Experience has taught the miners to look for diamonds in the distinct regions which have been named,—1. *Servico da Serra*; 2. *Servico do Campo*; 3. *Servico do Rio*; these three regions correspond exactly to itacolumite, to the metamorphic schist, and to the breccia spoken of before.

In the *Servico da Serra* the decomposed itacolumite, called *gurgulho*, forms pure quartz sand with fragments of the undecomposed rock and quartz. It fills the cavities caused by the destruction of the rock. Associated with the diamonds are always found rutile, anatase, and oxide of iron; and the presence of these minerals is always taken as indication that the earth contains diamonds. All these minerals are found in itacolumite, though difficult to distinguish without a previous washing; and the diamond has been obtained by blasting and washing the undecomposed rock.

2. The *gurgulho* of the *Servico do Campo* is found on the raised plains or plateaus, and not on the mountains. It occurs on the surface of the soil about the separation of the two great basins of San Francisco, and Jequitinhonha, and must have been formed *in situ* by the de-

* Communicated to the Royal Society.

† Abridged from the *Annales des Mines*, t. xvii., p. 289.

composition of subjacent rocks. Beneath the gurgulho, the rock forms a soft mass, which can be easily removed with a hoe. Since 1850 the soft rock has been worked to a great depth, with very good results. Between the barro, as the softened rock is termed, and the gurgulho, or completely decomposed rock, a transition layer is found, which is named *terra*, and in which diamonds are also found.

Everything seems to indicate that the barro is produced by the decomposition of the metamorphic schist. It is true that the diamond has never been found in the schist, but this is easily explained by the fact that the undecomposed rock has never been worked. When first dug out the barro is moist and soft, but it hardens in the air, and the diamonds are not at once detached in the washing. At Dinmantina the authors obtained a specimen which still enclosed a very large diamond.

3. The *Servico do Rio* includes the works established in the beds and on the banks of the rivers. In these the diamonds are found free from the usual gangue. The bed of the river is formed by the solid rock. The moveable soil resting upon the rock is often covered with large blocks obviously belonging to the itacolumite. When oxide of iron exists in the vicinity, the upper layers are seen to be cemented into a conglomerate (*canga*) in which diamonds are not unfrequently found.

The moveable soil (*cascalho*) contains products of the decomposition both of itacolumite and metamorphic schist; the minerals found are the same as those in *Servico da Terra*, and the *Servico do Campo*, but the forms are rounded, and sometimes one and sometimes the other predominates. The *cascalho*, it must also be remarked, contains quartz ornaments, flint implements, and bones, on the nature of which latter the authors do not venture to express an opinion.

Beyond all doubt itacolumite and the metamorphic schist are the ordinary repositories of the diamond and all the precious stones which accompany it, but they are not necessarily found in all parts of the formation any more than the green tourmaline of Campo Longo, and the realgar of Binnenthal are seen in all the dolomites of the Alps.

The diamond is found in the mountains of itacolumite of Grao Mayor, and in the numerous water-courses which take their rise in them; it exists, also, in many other mountains of itacolumite, but is too rare to be sought for profitably. Thus, in the Serra do Cipo, in the basin of San Francisco, we have seen four diamonds which were found in a small water-course at the upper part of the serra. On the other side the mountains may not contain diamonds, and this may be the case with Itacolumi itself, which has given the name to the rock.

Up to the present time the decomposed metamorphic schist of San Joao or Quinda is the only one in which the diamond has been observed; but the great extent of the *gurgulho do campo* shows that the schist is very widely spread, and diamonds may be found in various localities.

PHYSICAL SCIENCE.

On Drops.

MR. GUTHRIE, Professor of Chemistry and Physics at the Royal College, Mauritius, has made to the Royal Society an elaborate communication on Drops, from which we extract portions which have some practical interest to pharmacutists and prescribers:—

The author defines a drop as a mass of liquid collected

and held together by the attraction of its parts, and separated from other matter by the attraction of gravitation. It follows that the size of a drop may depend upon, and be influenced by, variation in—

1. The self-attraction and cohesion of the drop-generating liquid;
2. Its adhesion to the matter upon which the drop is formed;
3. The shape of the matter from which the drop moves;
4. The physical relation of the medium through which the drop moves, on the one hand, to the liquid of which the drop is formed, and on the other, to the matter on which it is formed;
5. The attraction of the earth, or gravitation, upon the drop-forming liquid and upon the medium, as influenced by their respective and relative densities, and by variation in the attracting power of the earth.

When a liquid drops from a solid through a gaseous medium, as atmospheric air, it may be asserted that a drop of the liquid will always be of the same size, if it is formed of the same liquid substance, and falls from a solid of the same substance, size, and shape, provided that the temperature remain the same, and the growth time, or length of the time interval between the successive drops, be constant.

We need not describe the plan adopted by the author for ensuring the regularity of the drops, which would indeed be unintelligible without a drawing; we must say, however, that the size of the drops was determined by weighing a noted number of them. The most prominent fact noticed by the author is that, on the whole, the drops undergo a continuous diminution in weight or size as the growth time increases. To such an extent is this the case that drops falling at the rate of sixty drops in twenty seconds were nearly twice as heavy as drops falling at the rate of one in every twelve seconds. This connexion between rate and weight (or quantity), the author very properly remarks, should not be lost sight of by prescribers and dispensers of medicine. A pharmacist who administers 100 drops of a liquid drug, delivered at the rate of three drops per second, may give half as much again as one who measures the same number at the rate of one drop in two seconds, and so on. The cause of this difference, it is observed, is probably to be sought for in the circumstance that when the flowing to the solid is more slow, the latter is covered with a thinner film of liquid, so that, as the drop parts, the solid reclaims by adhesion more of the root of the drop than is the case when the adhesion of the solid to the liquid can satisfy itself from the thicker film which surrounds the drop in the case of a more rapid flow.

Without detailing the numerous experiments made by the author to ascertain the sizes of drops obtained from various liquids under different conditions, we may quote the laws into which he collects the main results of his experiments in the case we have mentioned—namely, a liquid dropping from a solid through a gas.

Law 1.—The drop size depends upon the rate of dropping. Generally, the quicker the succession of the drops, the greater is the drop; the slower the rate, the more strictly is this the case. This law depends upon the difference, at different rates, of the thickness of the film from which the drop falls.

Law 2.—The drop size depends upon the nature and quantity of the solid which the dropping liquid holds in solution. If the liquid stands in no chemical relation to the solid, in general, the drop size diminishes as the quantity of solid contained in the liquid increases. The

cause of this seems to be that the stubborn cohesion of the liquid is diminished by the solid in solution. When one or more combinations between the liquid and solid are possible, the drop size depends upon indeterminate data.

For example: certain variations in the drop size of solutions of chloride of calcium of different strengths point to the existence of definite hydrates; while the regularity of the variation of drop size in the case of nitrate of potash points to the absence of hydrates.

Law 3.—The drop size depends upon the chemical nature of the dropping liquid, and little or nothing upon its density. Of all liquids examined, water has the greatest, and acetic acid the least drop size.

It is remarkable that butyric acid, which has sensibly the same specific gravity as water, gives rise to a drop less than half the size of the water drop.

Law 4.—The drop size depends upon the geometric relation between the solid and the liquid. If the solid be spherical, the largest drops fall from the largest spheres. Absolute difference in radii takes a greater effect upon drops formed from smaller, than upon those formed from larger spheres. Of circular horizontal planes, within certain limits, the size of the drop varies directly with the size of the plane.

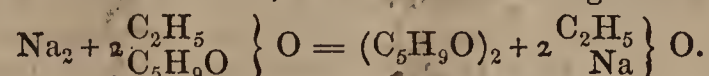
The fact that the drop increases in size according as the radius of the sphere increases from which the drop falls, and that the difference from this cause may amount to half the largest drop-size, the author regards as important to dispensers of medicine. The lip of a bottle from which a drop falls is usually annuloid. The amount of solid in contact with the dropping liquid is determined by the size of two diameters, one measuring the width of the rim of the neck, the other the thickness of that rim. In most cases the curvature and massing of the solid at the point whence the liquid drops is so irregular as not to admit of any mathematical expression.

Law 5.—The drop-size depends upon the chemical nature of the solid from which the drop falls, and little or nothing upon its density. Of all the solids examined antimony delivers the smallest, and tin the largest drops.

Law 6.—The drop-size depends upon temperature, generally the higher the temperature the smaller the drop. With water the effect of a change of temperature of 20° C. to 30° C. is very small.

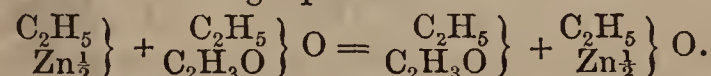
Law 7.—The nature or tension of the gaseous medium has little or no effect upon drop size.

ether, the products resulting from this reaction are ethylate* of the alkali metal, and the acid-forming radicals, *e.g.*,

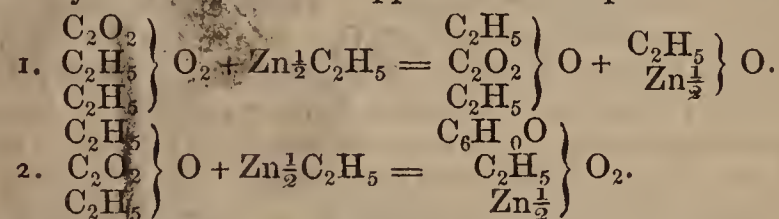


In the case of polybasic ethers the results of the reaction are, ethylate* of the alkali metals and either the acid-forming radical itself or else an ether of a reduced acid.

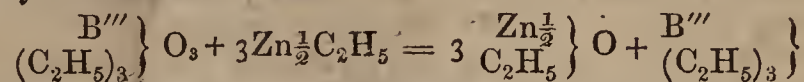
(*b.*) Organo-metallic bodies, such as zinc-ethyl, should give a metallic salt of the oxide of the alcohol radical and either a ketone or a reduced acid. The author expected zinc-ethyl would react upon acetate of ethyl, as represented in the following equation:—



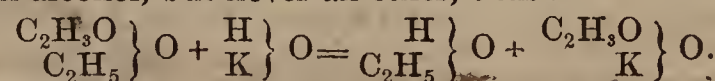
Here the metallic salt of the oxide of the alcohol-radical is ethylate of zinc; the ketone is ethyl-acetyl. On polybasic ethers the action of the organo-metallic bodies should be very similar—it should give a metallic salt of the alcohol radical and an ether of a reduced acid when it did not give a ketone. Frankland's research on the action of zinc-ethyl on oxalic acid supplies an example:—



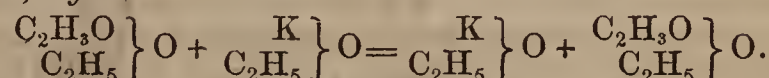
The first equation is strictly according to the theory; the second is a secondary action of zinc-ethyl upon the product of the first. Frankland's research on borate of ethyl affords an example of the action of an organo-metallic body on a tribasic ether.



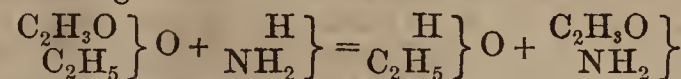
wherein ethide of boron represents the ketone of the tribasic radical. (*c.*) Potash or soda in alcoholic solution gives, with ethers of this class, a salt of potash or soda and an alcohol, but never an ether, thus:—



(*d.*) Ethylate of potassium or ethylate of sodium gives no ether, *e.g.*—



(*e.*) Ammonia gives with ethers of this class an amide, *e.g.*—



In all these reactions it is, as will be noticed, the acid-forming radical—not the alcohol-forming radical, which is exchangeable. Adopting a nomenclature in accordance with these notions, we should have—

New.	Old.
Ethylate of valeryl	= Valerate of ethyl.
Ethylate of acetyl	= Acetate of ethyl.
Amylate of acetyl	= Acetate of amyl.
Tri-ethylate of boron	= Borate of ethyl.
&c.	&c.

Class II. comprehends ethers which are true salts of the alcohol-radical, wherein the alcohol-radical, and not the acid-forming radical, is replaceable. To it belong—

Iodides	of alcohol-radicals.
Bromides	"
Chlorides	"
Nitrates	"
Nitrites	"
Fluorides (?)	"

And some others.

The characteristics of Class II. are quite different from those of Class I. Thus the members of Class II. give with (*a.*) metals, alcohol radicals; (*b.*) organo-metallic

* Ethylate, or methylate, or amylate, &c., as the case may be.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 17.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,
in the Chair.

(Continued from page 257.)

PROFESSOR WANKLYN read a paper "On the Nature of Compound Ethers," in which he proposed to classify the compound ethers accordingly as they are—so to speak—salts of the acid-forming or of the alcohol-forming radicals which they contain.

Class I. comprehends ethers in which the acid-forming radical is replaceable. To it belong the ethers of the fatty and aromatic acids, the oxalic ethers, the carbonic, silicic, and boracic ethers, and some others. Certain characters are common to these ethers:—(*a.*) The alkali-metals, potassium and sodium, displace the acid-forming radicals when they act upon ethers of this class. In the case of the mono-basic ethers, *e.g.*, valerianic ether, benzoic

bodies, double alcohol radical; (c) potash or soda, an ether, and sometimes an alcohol besides; (d) ethylate of potash or soda, a double ether; (e) ammonia, a compound ammonia. It is thus seen that the members of Class II. exhibit the alcohol radical contained in them as the moveable portion. They should, therefore, retain their old names.

Class. III. may, perhaps, be made to embrace common ether, the anhydrides, &c., being made up of compounds in which the radicals are equally replaceable.

The foregoing classification is intended by the author to serve as a sort of programme for the work which he has chalked out for himself. Many of the characteristics assigned to the different ethers are at present known to belong to them; others—as, for example, the production of ketones by the reaction of organo-metallic bodies on the fatty ethers—are not at present known to be applicable to those ethers. The author is engaged in making experiments with the view of establishing the justice of this classification.

Professor WANKLYN also read a “*Note on Valerianate of Ethyl and Acetate of Amyl.*” These ethers are isomers, both having the formula $C_7H_{14}O_2$. In the text-books both are said to boil at $133^\circ C$. The author has recently made the observation that whilst the boiling point of valerianate of ethyl is actually $133^\circ C$, acetate of amyl boils at $141^\circ C$; and Mr. Wanklyn believes that former observers have not had their acetate of amyl free from amylic alcohol, and attributes the low boiling point which they have assigned to it to the presence of the alcohol. An organic analysis will not reveal the presence of 5 per cent. of amylic alcohol in a specimen of acetate of amyl; and if a trace of moisture be also present, it will hardly show the admixture of 10 per cent. Mr. Wanklyn prepared his acetate of amyl in the usual manner, excepting the employment of a double proportion of sulphuric acid; and the product was twice digested with chloride of calcium to ensure its perfect dryness. It was incidentally noticed that the calcium salt was soluble to the extent of about 5 per cent. in acetate of amyl. For its analysis the author employed an alkalimetric method, which he considered offered advantages over the ordinary process of combustion.

Dr. FRANKLAND, after offering some speculative views upon the possible nature of the reaction exerted between potassium and boride of ethyl, proceeded to give a sketch of some experiments recently performed by Mr. Duppa and himself, in which sodium was made to act upon mixtures of acetic ether with the iodide of methyl or of ethyl; they had already succeeded in producing two new bodies having the formulæ— $C_8H_{14}O_3$ and $C_9H_{16}O_3$ respectively, the first being, of course, derived from the iodide of methyl, and the second from the ethyl compound. The formula of leucic ether, $C_8H_{16}O_3$ stood in close relationship with the new bodies, but their constitution was not yet sufficiently defined to permit of any further statement being made in regard to them.

Professor WANKLYN said he could not throw light upon the inquiry started by Dr. Frankland with reference to the boride of ethyl. By acting with sodium upon acetic ether, the speaker did not succeed in isolating the radical, acetyl; it seemed at the moment of liberation to unite with the elements of ethylate of sodium, and produce leucate of soda. A similar reaction was observed in the case of the decomposition of acetate of amyl by sodium.

The meeting was then adjourned until December 1, as already announced.

LECTURES ON CHEMICAL PHILOSOPHY.—VII.

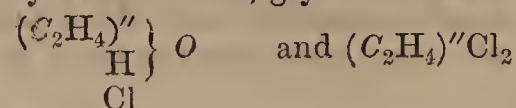
Delivered at the College of France, by M. A. WURTZ.

Condensed Types.

(Continued from page 258.)

We may follow out in other compounds the analogy we

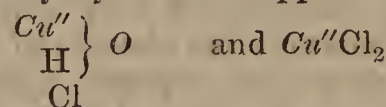
have sought to establish between the diatomic, mineral, and organic hydrates. Thus, glycol forms two chlorides—



Monochlorhydric
glycol.

Dichloride of
ethylene.

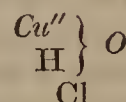
In the same way hydrate of copper forms two chlorides:



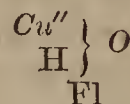
Cupric
monochlorhydrine.

Dichloride of
copper.

The compound

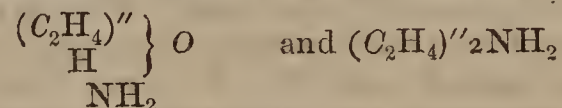


is not known, but there does exist an analogous fluorhydric compound—



which was discovered by Berzelius, who attributed to it the formula $CuO, CuFl, HO$, which may be compared with our own, if we double the atomic weights of the oxygen and copper.

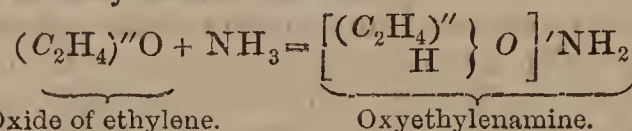
The formulæ of glycol and cupric hydrate further inform us that there ought to exist two ethylenic amides, and two cupric amides. The two former have been produced:



Oxyethylenamine.

Ethylene-diamine.

The first of these bodies is formed by the direct addition of oxide of ethylene to ammonia—

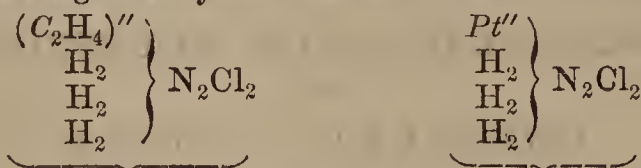


Oxide of ethylene.

Oxyethylenamine.

We may regard it as ammonia in which H has been replaced by the monatomic group $[C_2H_4, HO]$. Ethylene-diamine results from the substitution of $(C_2H_4)''$ for H_2 in two molecules of ammonia.

In the same way there exist cupric, cobaltic, and platinic ammonias. To take only one example:—We may compare platsonium, that is to say, the radical of the green salt of Magnus with ethylene-diamonium—that is, the ammonium corresponding to ethylene-diamine.

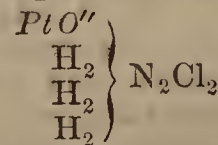


Chloride of ethylene-diammonium.

Chloride of platsonium.
(Magnus' green compound.)

And this comparison is legitimate, for just as chloride of ethylene-diammonium is formed by the direct addition of chloride of ethylene to two molecules of ammonia, so Magnus' green compound is formed by the direct addition of platinous chloride, $Pt''Cl_2$, to two molecules of ammonia.

We do not know platinic bases strictly comparable with oxyethylenamine. There exist, however, oxyplatinic bases, and we know an oxyplatammonium in which the group $(PtO)''$ plays the part of a diatomic radical.

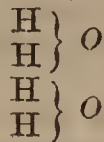


Chloride of oxyplatammonium (Gerhardt).

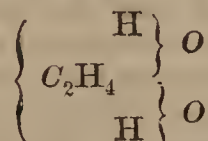
We might, perhaps, compare oxyethylenamine with

the remarkable base discovered some years ago by Millon, which results from the addition of mercuric oxide to ammonia, just as oxyethylenamine results from the addition of oxide of ethylene to ammonia. But we will not pursue this subject further.

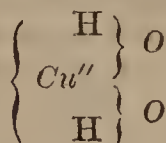
In all the compounds which we have considered, and which belong to the condensed types, the part of the polyatomic elements of mineral chemistry is exactly comparable with the part of the compound radicals of organic chemistry. These elements and these radicals possess the power of consolidating several molecules encroaching, so to say, upon each of them. If in two molecules of water



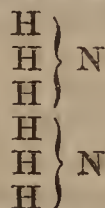
we substitute the radical $(\text{C}_2\text{H}_4)''$ for H_2 , there is formed the compound



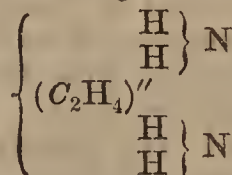
This radical, since it is indivisible, takes the place of two atoms of hydrogen, and there binds together the remaining atoms so as to form a single complex molecule. In hydrate of copper the same thing takes place: the indivisible atom of copper is substituted for H in each molecule of water and consolidates the remainder.



The diatomic radicals play the same part in condensed ammonias. Thus two molecules of ammonia

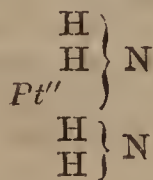


are welded together by the substitution of $(\text{C}_2\text{H}_4)''$ for H in each of them, thus forming—



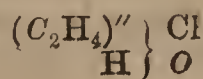
that is to say, ethylene-diamine. The two ammoniacal residues are riveted together by the indivisible diatomic radical $(\text{C}_2\text{H}_4)''$.

We conceive the same of the part of platinum in platamine—

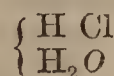


We shall return to these considerations by-and-by; but we should give but an incomplete idea of the theory of types if we did not add that elements and polyatomic radicals may also consolidate or weld together different molecules: one molecule of hydrochloric acid, one molecule of water, and one molecule of ammonia, for example. This is the principle of the *mixed types* introduced by Dr. Odling, about which we proceed to say a few words.

By acting on glycol with hydrochloric acid, I have obtained a compound which I have called monochlorhydric glycol. It contains $\text{C}_2\text{H}_5\text{ClO}$, and we may express its composition by the formula—



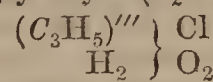
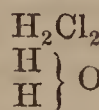
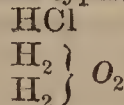
and so bring it under the mixed type—



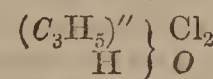
We see here the part of the diatomic radical ethylene. It is substituted for H in the molecule of hydrochloric acid, and for H in the molecule of water, and encroaching upon both these molecules, it welds one to the other, because it is itself indivisible.

By analogous formulæ we may represent the monochlorhydric and dichlorhydric which Berthelot has obtained by making hydrochloric acid react upon glycerine. The following formulæ, which express the composition of these bodies, indicate at the same time with sufficient exactness the part of the triatomic radical glycyle $(\text{C}_2\text{H}_5)'''$:—

Mixed types.

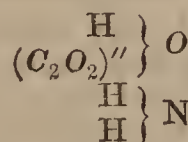


Monochlorhydric.

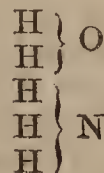


Dichlorhydric.

Lastly, we may represent the constitution of oxamic acid by the formula—



in which we see the diatomic radical oxalyle C_2O_2 weld together a molecule of water and a molecule of ammonia in the type—



But the elements and the polyatomic radicals possess still another remarkable property: they are capable of accumulating in the complex compounds of mineral and organic chemistry. We shall enlarge upon this in the next lecture.

ACADEMY OF SCIENCES.

November 21.

A VERY interesting communication on vegetable physiology was read by M. Naudin. It was entitled "*On Hybridity considered as a Cause of Variability in Vegetables.*" The experiments and the results detailed merit the particular attention of botanists and horticulturists. The general result, however, appears to be what has been before observed, namely, that whatever variations may be produced, no permanently new species are obtained by crossing the plants.

M. Burdin read a paper "*On Heated Air as a Substitute for Steam as a Motive Power.*" A few weeks ago the author announced to the Academy that he had come to Paris expressly to replace steam with heated air in locomotives, boats, &c. To-day he made it quite clear upon paper that with his machine he could produce all the force with a much smaller expenditure of fuel. It is not said whether his machine is in existence or not.

France must once have been a very thickly-populated country. M. Bourdain has discovered *Two New Deposits of Flint Implements*—one in Paris itself, and the other an hour's distance. The gravel in the squares, promenades, and gardens of the city, the author says, contain archaeological treasures—a prodigious quantity of arrow-heads and such like.

M. Jodin presented a note "*On the Chemical Action of Light on some Immediate Vegetable Principles.*" Everybody knows that, under the influence of light, tannin, chlorophyll, and other vegetable matters absorb oxygen

and give off carbonic acid, and will not do so in the dark. The author repeats this statement.

M. Berthelot presented another note "*On the Decomposition of Formic Acid.*" We announced last week that the author could decompose formic acid into either carbonic oxide and water, or into carbonic acid and hydrogen. The difference in the decomposition, it seems, depends on the completeness of the process. If only a portion of the formic acid be decomposed, carbonic oxide and water result; but if all the acid is broken up, carbonic acid and hydrogen result. The first decomposition represents the initial effects of the heat, and takes place in an excess of acid. The second represents the final effect, and takes place when the whole of the acid disappears. The decompositions are effected by a longer or shorter exposure to the heat. In the first case the acid was kept at 260° C. for eight hours; in the second, the exposure to a like temperature lasted twenty-five hours. A short exposure to 300° of heat effected no decomposition. The author dwells on the influence of time, and remarks that the same is observed in the formation of the acid. The calorific phenomena observed during the decomposition will be referred to in another paper.

M. Fleury, in a note "*On the Heat of the Combustion of Formic Acid,*" seeks to explain the anomaly remarked by M. Berthelot. M. Fleury observed very truly that there is nothing to prove that in the formation of formic acid from carbonic oxide and water, the carbon in the CO does not separate from the oxygen before it combines to form the indivisible group $C_2H_2O_4$. On the contrary, he says, the unitary theory repudiates the notion of the persistence of the simpler molecular groups in the more complex groups which they go to make up. Here, then, in this decomposition of carbonic oxide is the "negative work," which, according to M. Berthelot, causes the absorption of heat, the disengagement of which in the combustion of formic acid so puzzles him. The intervention of time, M. Fleury says, explains nothing, for the time a phenomenon takes to accomplish has no relation to the heat necessary to produce it.

NOTICES OF BOOKS.

A Manual of Chemical Analysis, Qualitative and Quantitative. For the use of Students. Part II.—Quantitative. By H. M. NOAD, Ph.D., F.R.S., &c. London: Lovell Reeve and Co. 1864.

DR. NOAD'S "Manual" is a well-known book; and, although there is no announcement to the effect on the title-page, every middle-aged chemist will see at once that this is the earlier work in another form. But it is now many years since that work was published, and in the interval chemical analysis has made great progress. Many old and imperfect processes have been discarded, and new and better methods introduced. It is no mean praise to say that Dr. Noad is an industrious reader as well as an expert analyst, and has brought his book well up to the times by inserting every process of value which has been published up to a very recent date. We might especially point to the methods for estimating phosphoric and nitric acids as illustrating the truth of this remark, since in these we find all the best recently introduced methods fully described. We have no space for long quotations; but we come upon one passage which we extract, because it will serve to answer the question of a correspondent who addressed our readers a few weeks ago wanting a process for the detection of sulphur in hops. Here is one:—"By this test (nitro-prusside of sodium) the presence of sulphur in hops, wines, silk, &c., is easily detected. The substance under examination is placed in a flask with a piece of sheet zinc, diluted hydrochloric acid is poured over it, and the gas conducted into the solution of nitro-prusside. If the gas contain but a minim of sulphuretted

hydrogen, the first bubble causes a violet cloud in the solution: after passing the gas for a short time it assumes the magnificent colour of a solution of permanganate of potassa. The vapour of hydrochloric acid passing over with the gas may be arrested by filtering it through cotton wool, though it does not affect the reaction unless it be continued too long."

Annales de Chimie et de Physique. October, 1864.

(Continued from page 260.)

THE remainder of M. Wurtz's paper is devoted to the *diallylic compounds* and *hexylic glycol*, an isomer of dihydrate of diallyle. The paper will be found of great interest to those who make this kind of chemistry their study.

The only other paper in the *Annales* is M. Peligot's "*Researches on the Organic Matters Contained in Waters.*" The author, in the course of his examination of the water of the Seine, remarked that the precipitate produced by nitrate of silver always contained a certain proportion of organic matter. It became black when heated, and gave off ammoniacal vapours. When nitrate of lead was substituted for the nitrate of silver, the presence of the organic matter was still more clearly indicated. The precipitate, when heated, gave off an empyreumatic odour resembling that from burning wool. Most metallic salts he found to carry down the organic matter, but the most decided precipitant was perchloride of iron, which quickly occasioned the formation of ochre-coloured flocculi composed of ferric hydrate and organic matter. The author here remarks that the action of the perchloride of iron on many organic matters in water is prompt and most remarkable. He says it is an energetic and very efficacious disinfectant, which instantly removes from marshy and putrid waters their characteristic odour.

In the course of his investigations, M. Peligot discovered an easy method of separating the greater part, if not the whole, of the organic matter, at all events, that which is susceptible of combining with a metallic oxide. The process will, perhaps, be useful to some who may desire to estimate crenic and apocrenic acid, for the author's analysis of the organic matter separated closely corresponds with Mulder's analysis of apocrenic acid.

The precipitate produced in Seine water by nitrate of lead was found to be composed of carbonate, sulphate, and subnitrate of lead, together with the organic matter in combination with oxide of lead. A slight excess of very dilute nitric acid will dissolve from this mixed precipitate all but the sulphate. By adding to the solution obtained milk of lime, subnitrate of lead is precipitated, and also the compound of organic matter and oxide. Boiling water dissolves the subnitrate, and thus isolates the organic compound. This is a yellowish matter, which must be well washed on a filter to remove all excess of lead, and then dried over quicklime, and lastly at 110° . The specimen analysed by the author was composed of 65.7 oxide of lead, and 34.3 of organic matter. The organic matter had the following composition:—

Carbon	.	.	.	.	.	53.1
Hydrogen	.	.	.	.	.	2.7
Nitrogen	.	.	.	.	.	2.4
Oxygen	.	.	.	.	.	41.8
						100.0

Mulder, in his analysis of apocrenate of copper, obtained the following numbers:—

Carbon	.	.	.	.	.	51.8
Hydrogen	.	.	.	.	.	3.7
Nitrogen	.	.	.	.	.	3.3
Oxygen	.	.	.	.	.	41.2
						100.0

The remainder of M. Peligot's observations apply only to French waters, and have no general interest.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2538. Richard Wright, Barge Yard, Bucklersbury, London, "Improvements in preparing saccharine matters."—Petition recorded October 14, 1864.

2607. Arthur Reynolds, Bagillt, Flintshire, "Improved mode of manufacturing sulphuric acid."

2614. George Edmund Donisthorpe, Leeds, Yorkshire, "Improvements in obtaining grease from wash waters."—Petitions recorded October 21, 1864.

2675. Alexander Parkes, Birmingham, in the county of Warwick, "Improvements in manufacturing compounds of gun-cotton, and other vegetable substances similarly prepared, also in the preparation of castor and cotton oils and gum ballata, to be used with or separate from such compounds."—Petition recorded October 28, 1864.

2734. Frederick Yates, Birmingham, Warwickshire, "Improved apparatus for generating combustible gases."—Petition recorded November 4, 1864.

2776. Adolphe Moreau, Chancery Lane, Middlesex, "Improvements in extracting silver from lead." A communication from Don Francisco Marques Millandel Real, Rue Mautree, Bordeaux, France.—Petition recorded November 8, 1864.

Notices to Proceed.

1691. James Wilson, Exeter, Devonshire, and Walbrook, London, "Improvements in tanning, and in the machinery or apparatus employed therein."—Petition recorded July 7, 1864.

1695. Alfred Blake, Castle Brewery, Newport, Monmouthshire, "Improving water for the purpose of brewing, and beer produced therefrom."—Petition recorded July 8, 1864.

1727. Stephen Carey, East Ham, Essex, "Improvements in apparatus for calcining bones, and for re-burning and revivifying animal charcoal."

1729. Ludwig Schad, Cassel, Electorate of Hesse, at present residing at Warrington, Lancashire, "Improvements in the manufacture of pigments."—Petitions recorded July 12, 1864.

1744. Victor Pean and Alphonse Francois Le Gros, Rue de la Fidélité, Paris, France, "Certain improvements in coffins, and for preventing noxious emanations from dead bodies."—Petition recorded July 3, 1864.

1784. Amelie Angelina Bonnet, Rue de la Fidélité, Paris, France, "Certain improvements in the mode of preparing and applying chemical fumigations to the treatment of human diseases, and in apparatus connected therewith."—Partly a communication from her late husband (M. Leon Bonnet), and partly invented by herself.—Petition recorded July 16, 1864.

1795. Frederick Seeborn, Düsseldorf, Prussia, and town and county of Newcastle-upon-Tyne, "Improvements in the manufacture of iron."—Petition recorded July 18, 1864.

1804. Henry Edward Francis De Brion, Welbeck Street, Cavendish Square, Middlesex, "An improved composition for protecting and preserving metals, such as iron, copper, and zinc, used in the construction of ships or in the protection of their sides and bottoms from oxidation and corrosion from the action of sea water, and for protecting from corrosion all submerged substances, such as chains, anchors, cables, and every oxidable metals submerged in water or exposed to atmospheric influences."—Petition recorded July 19, 1864.

1823. Alfred Vincent Newton, Chancery Lane, Middlesex, "Improvements in electro-telegraphic apparatus."—A communication from Royal House, New York, U.S.A.—Petition recorded July 21, 1864.

2347. Archibald Henry Plantagenet Stuart Wortley,

Rosslyn House, Grove End Road, in the parish of St. Marylebone, and the Honourable William Warren Vernon, Rutland Gate, Hyde Park, both in Middlesex, "A new chemical process for producing photographic pictures, and in the preparation and manner of using the materials in such process."—A communication from Jacob Wothlij, Aix-la-Chapelle, Prussia.—Petition recorded September 24, 1864.

2460. Benedict Margulies, Trieste, Austria, but now residing at St. Helens, Lancashire, and John Knowles Leather, of the same place, "Improvements in the manufacture of salts of chromium."—Petition recorded October 6, 1864.

2661. John Stobo and William Pollock, Seven Bank Works, near Bonhill, in the county of Dumbarton, N.B., "Improvements in tramping, wringing, and delivering yarns in connection with dyeing and bleaching processes."—Petition recorded October 27, 1864.

2668. John Charlton and Henry Charlton, Strangeways, Lancashire, and John Osborne Christian, F.C.S., Manchester, in the same county, "Certain improvements in sizing, dressing, filling, and stiffening yarns or fabrics composed of cotton, linen, silk, wool, or other fibrous materials or paper, whereby such materials are also rendered non-inflammable."—Petition recorded October 28, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, November 30.

LAST week some experiments with an electric brake were made on the Strasburg railway. I have not been able to meet with a complete description of the apparatus, but it seems that a system of brakes attached to any number of carriages in a train is brought into operation by interrupting an electric current by means of a little apparatus attached to the tender, and thus under the control of the driver. When contact is made and the current is established again, the brakes cease to act. Connected with this is an arrangement by which the guard and even the passengers can communicate with the engine-driver. The experiments made showed that all the contrivances were perfectly effective, trains going at great speed being brought to rest at a distance of 250 to 300 metres, instead of from 1200 to 1500 as by the usual system of brakes. I should hope some arrangement of the sort will be adopted on all railways.

The part which electricity plays in the affair is evidently very small, but M. Dumas praised this application of a current very highly in his report to the Emperor on the allotment of the prize of 50,000 francs.

Signor Marini has come to Paris with his preparations, and anybody who wishes to be disgusted may see at the Hotel Mazarin a round table entirely made up of a sort of mosaic of petrified brain, blood, bile, &c. You must imagine the etceteras! He has some other things not so disgusting, but quite as useless—dried or mummified limbs, for instance—which, by injecting, he can make to look as if they came from a recently deceased body. If "subjects" were scarce the process might prove of some utility, but as it is I do not see what scientific purpose can be served. The process may have an interest for people of morbid tastes, like Dr. Martin Van Butchell, who, I think it was, kept his two dead wives in his bedroom. He married a third, who insisted on the interment of her rivals before she would go to the altar. But it may be objected that Signor Marini's process is a contravention of the laws of nature, which seem to have ordained that mortals shall eventually become manure; and the objection is the stronger in so far as it is only in the capacity of manure makers that a great many mortals ever do any good in the world.

Turning to more savoury matters, I may mention, for the sake of any lovers of Burgundy among your readers, that the jury which sits annually on this respectable beverage reports that this year's vintage is "particularly fine"—as, by the way, I have seen a certain F.C.S. report in print of a London tradesman's ducks' eggs. The produce (of Burgundy, not ducks' eggs) is rather smaller than usual, but the quality of both red and white wine is exceptionally good. It is a curious fact that the vine has never been affected by the oïdium in Burgundy.

A Doctor Girouard, of Chartres, has made the curious discovery that a vacuum can be produced by means of a current of air. If, for example, you have a vessel with a small aperture, and you blow a strong current of air across this aperture, you produce a vacuum in the interior of the vessel. You can render this evident in the following way:—Set an ordinary bell-glass, furnished with a stop-cock, on a dish of water, and, with a blow-pipe or glass tube, send a strong current of air across the mouth of the stop-cock. The current will be found to carry away with it air from the inside of the bell-glass, into which, accordingly, the water will rise. As another correspondent of *Les Mondes* remarks, this experiment may lead to new explanations of a number of meteorological phenomena, and the principle appears susceptible of utilisation.

I have mentioned before the evening classes opened at Mulhouse. We have now the numbers who have entered to attend them. They number nearly 700, out of which number 71 have joined the English class.

A varnish made of pitch dissolved in sulphide of carbon has been introduced here for preserving wood and metals. I have no doubt it is very useful, but I am sorry for the people who are obliged to apply it.

Among the papers read at the last meeting of the Academy of Sciences, of which I dare say you will only find the titles in the *Comptes Rendus*, I may mention one by M. Chassaing, who lays it down as a rule that a first-born daughter always strongly resembles her father. Newly-married men should make a note of this law.

On the Difference in Gases arising from Various Metals, &c., under Action of Heat.

To the Editor of the CHEMICAL NEWS.

SIR,—As this is a chemical question, and one that I have never met with in print, I would draw attention to it to elicit any information on the subject. I am at present going to try copper pipes (drawn, not brazed) heated to be the means of generating heat; and the air will be forced through by blow-fan to effect boiling of liquids beyond a certain density, and possibly for inflation of balloons. Copper is preferable to iron in many respects; it does not crack or rend; it is easily patched; and the gas from it will not flavour some things as sugar so much as iron. I shall be glad to hear comments and dissents to my plan.

I am, &c., C. M. K. Dick,
(late of Trinidad, sugar planter).

MISCELLANEOUS.

Royal Institution.—The general monthly meeting will take place on Monday, December 5, at 2 o'clock.

Pharmaceutical Society.—The next Pharmaceutical meeting will take place on Wednesday evening, December 7, at 8 o'clock. The chair will be taken at 8.30 precisely. The following papers will be read:—"On the Gamboge Tree of Siam," by Daniel Hanbury, F.L.S. "On the Extracts of Hop and Rhatany," by Mr. A. F. Haselden. "On Nitrite of Soda," by Mr. A. J. Roberts. At the Pharmaceutical meeting on Wednesday evening, January 4, a paper "On Perchloride of Iron and its Solutions, and the Various Processes for its Preparation," by J. Attfield, Ph.D., F.C.S.

The Wholesale and Export Drug Company (Limited).—A company with the above name has been projected, by taking shares in, and dealing with which, chemists and druggists may secure all the advantages of the co-operative system. The undertaking comes before the public recommended by the adhesion of a considerable number of chemists and druggists; and with the application of the Limited Liability Act to provide capital, and the principle of co-operation to secure connexion, we see no reason why, with good management, the shareholders should not realise a very handsome return, and we wish the chemists and druggists every success.

Photographs of Natural Colours.—M. Niepce de St. Victor is still pursuing his investigations on the above interesting subject. Some of his recent observations are of great importance. He makes use of baths of soluble chlorides to obtain a sensitive surface, and he has found that the chlorides which give coloured flames reproduce objects of the same colour as the flame. Chloride of strontium, for example, gives him a surface which reproduces the red colour of an object; and thus by using baths of variable composition, in which the chloride corresponding to the predominating colour is in the largest proportion, M. Niepce obtains representations of natural colours. They are not permanent, however. Chlorine, chloride of copper, and perchloride of iron appear, it is said, to be the best agents, and by varying the dose of the chlorine and chloride he obtains certain colours in a marked manner.

Serious Case of Poisoning.—An inquest was commenced at York on Monday respecting the death of Elizabeth Nuttall, wife of Henry Nuttall, a brass finisher, living near Oxford-street, London. Deceased was a native of York, and was visiting there at the time of her death for the benefit of her native air. For twelve or thirteen years she has been subject to palpitation of the heart, and during the whole of that time had taken morphia for its relief. Her husband had also from illness been addicted to morphia, taking as much as thirty grains a day; but believing that it did neither himself nor his wife good, he gradually broke off the habit. On Saturday afternoon Mrs. Nuttall sent to the shop of Mr. Hardman, druggist, of York, for five grains of morphia, and her daughter brought back with her a powder closely resembling it. Mrs. Nuttall at once took it in water, but instead of finding relief was attacked with what at first appeared to be spasms, but what subsequently, from the aching of the back, the clenching of the hands, and other symptoms, led to the belief that she was labouring under the influence of strychnia. She died in half an hour from the time of taking the powder. Deceased's daughter said her mother, before taking the powder, remarked that it swam on the surface of the water, instead of sinking to the bottom as usual. She was served with the powder by a Christopher Powell, who had not assisted her before. At the time the daughter went for the poison, Mr. Hardman was absent, and the bottle from whence the poison was served was in a drawer with other poisons, one of which was strychnia. Powell is a porter in Mr. Hardman's establishment, can read labels, and had frequently served various other articles before. The jury adjourned the inquest for the purposes of a post-mortem examination and analysis of the contents of the stomach. This looks like another result of keeping strychnia in powder instead of crystals.

ANSWERS TO CORRESPONDENTS.

J. W.—Apply to Williams and Norgate.

E. J. Mills.—Received with thanks. The suggestion will most certainly be attended to.

W. E. S. W., Rochester.—See the appendix to the last edition of Fownes's Chemistry and Wurtz's lectures in the CHEMICAL NEWS.

E. J.—Dilute chloride of palladium does not give a precipitate in a concentrated solution of iodide of potassium. The protonitrate of palladium should be used.

LONDON SEWAGE.

THIS production, which was described by Mr. Tite at the late meeting of the British Association as the achievement of "Mr. Chadwick and the wisest men," has already been a source of great discomfort and trouble, and seems to promise further results of a similar kind. Indeed, the difficulties of dealing with sewage appear to be only just coming into view, and to be far greater than were anticipated. The Metropolitan Board of Works had only just taken in hand to oppose its invasion of the Thames by means of their intercepting sewers, as Mrs. Partington opposed the Atlantic with her mop, when the towns in the higher parts of the Thames valley, naturally following the precepts and example of the "wisest men," sought to dispose of their refuse as sewage, a course which involved the possible contingency of supplying London coffee-pots with the proceeds of Oxford slop-pails, and rendering the Thames as foul from another source as it once was from receiving the refuse of London.

There are many who have grave doubts as to the "water carriage" system adopted in London for getting rid of the town refuse, being the best means of effecting that object even when considered only as a matter of sanitary economy. But in that respect it is at least efficient so far as the condition of dwellings is concerned, and in the case of London it has been adopted to such an extent, that any change may now be regarded as impracticable. When the intercepting sewers are completed, and the sewage of London can be entirely discharged into the Thames at a distance from London, it may be reasonably be hoped that, by means of the large outlay which has been incurred, it will have been placed beyond the possibility of being a further source of annoyance, and that there will neither be a reflux of it up the river, nor a pestilence at the place where it is discharged.

But these considerations relate merely to the getting rid of the sewage, which it is the business of the inhabitants of London to do and to pay for being done. There is, however, another aspect of this material, in which it deserves further consideration: it is the agricultural value of certain ingredients of sewage. These are chiefly phosphoric acid, potash, and ammonia. Of these substances, the first and last named are the most important constituents of artificial manures which are necessary, under the existing agricultural system, for obtaining a sufficiently large amount of produce from land.

Phosphoric acid—probably the most valuable of all in this respect—is imported into this country for use as manure to an enormous extent, probably equivalent to more than 100,000 tons of phosphates annually. Ammonia and potash are also imported and used for the same purpose, either directly or for the most part in the state of cattle food.

By these means the exhaustion of land, of which there has been so much idle talk, is not only prevented, but is probably more than compensated for, especially in the case of the better managed farms, which are becoming now the rule rather than the exception.

But still there is a waste of material possessing value as manure, which results from the mode in which the refuse of towns is disposed of. If it be assumed that in the case of land farmed on the most approved system, there is sold off each acre in the course of four years, thirty bushels of wheat, thirty-five bushels of barley, and the meat produced from ten tons of turnips, two tons of hay, besides imported cattle food, then there would be re-

moved in the produce exported per acre every year, about eight pounds of phosphoric acid and five pounds of potash. The produce containing these substances, being consumed as food in towns, they pass into the excretal refuse, and, where the water carriage system is adopted, into the sewage.

The aggregate value of these ingredients of sewage will therefore be very considerable in the case of London, and proportionate to the quantity of corn, meat, &c., consumed as food by the population. It would be somewhat hazardous to express in figures the value of these ingredients, but if the value of the quantities of phosphoric acid, ammonia, and potash amount to 6s. per head per annum it would be very considerable. It is therefore very desirable that attention should be directed to the means by which this material may be made useful in contributing towards the production of corn and meat, equivalent to that from which it has been derived.

The attempt to effect this object by precipitating the sewage with lime, &c., which was in favour some years ago, and which was so obstinately persisted in with such a total disregard of known facts, and notwithstanding its palpable absurdity, is now tolerably well forgotten, and the results which have been obtained by applying sewage to waste land, as, for instance, at Edinburgh, have been in certain respects so advantageous, that after having been disregarded and even denied for some time, they have at length been the means of inspiring a belief in the possibility of realising great profits from such an application of sewage. Under the influence of such a belief, and with a convenient absence of any sound acquaintance with the subject of manuring, or of the value of various ingredients of manure, and of the conditions under which they are useful, the idea has become prevalent that sewage ought to be a source of profit as a saleable commodity, instead of involving outlay in getting rid of it.

Such an idea, though grateful enough to vestries and ratepayers, has a very dubious foundation, and though it doubtless possesses the qualifications for being made up into an attractive form as the stock in trade of a "limited" company, it is so far from being a trustworthy basis of speculation, that we consider it worth while to examine, from a chemical point of view, more in detail the proposals and the probabilities of the several schemes which have been put forward with the view of "making London sewage pay," a project which now enjoys the conjoint patronage of Lord Robert Montague, the Common Council of the City of London, Dr. Brady, Baron Liebig, and Mr. Meehi.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Solubility of Gold in Acids,
by ARTHUR REYNOLDS, B.Sc.

SOME time ago I communicated to the CHEMICAL NEWS some remarks on the solubility of gold in a mixture of sulphuric and nitric acids. I have since made some more experiments on this point.

A solution of chloride of gold, when heated in the same manner with sulphuric acid, forms a solution similar to that of gold in a mixture of sulphuric and nitric acids. It is precipitated by water. The solution, whether formed by heating gold with nitric and sulphuric acids or by heating chloride with sulphuric acid, gives a deposit of metallic gold on continuing the heat,

and when all the nitric acid is driven off the whole of the gold is deposited.

Nitric acid in excess prevents the precipitation by water, but the gold dissolves better when the sulphuric acid has a little water with it and only a small quantity of nitric acid.

Contributions to the History of Thallium,
by G. WERTHER.

I SHALL, for the present, only give the results of my further inquiries into the combinations of thallium, with reference to the proto-salts, but hope later to bring to a somewhat satisfactory conclusion the apparently scanty information which analysis has yielded concerning the per-salts.

The fact of the isomorphism of oxide of thallium with potash, which I have established by means of its double sulphate with magnesia, leaves no doubt that we must, with R. Böttger and Dumas, place thallium by the side of potash in the systematic arrangement of undecomposed bodies, and not, as Crookes and Miller think, with lead and silver. I have followed up this isomorphism through several double sulphates as well as double salts of selenic acid, and finally with salts which contained potash and oxide of thallium on the one hand, and magnesia oxide of zinc and oxide of copper united with selenic acid on the other. All these isomorphous double salts showed a preponderance of the crystalline form of the double sulphate of zinc and thallium already described, but were distinguished from the corresponding order of seleniates by the constant absence of $2r'$, as well as by other phenomena which caused me subsequently to inquire into the influence which the introduction of different metallic oxides into an isomorphous group mixture produced in their crystalline form. I remarked, by the way, that the double seleniate of zinc and thallium— $ZnOSeO_3 + TlOSeO_3 + 6HO$, gave, upon measurement, the following result:—

$$\left. \begin{array}{l} c : p = 102^\circ 50' \\ p : p = 71^\circ 12' \\ c : q = 154^\circ 9' \end{array} \right\} \text{hence } \begin{array}{l} o = 74^\circ 9' \\ a : b : c = 0.7442 : 1 : 0.5036. \end{array}$$

This salt resembles, throughout, the corresponding sulphate, but is difficultly soluble in water. I have also tried to follow up the isomorphism through other simple salts of thallium, and have chosen for that purpose the hyposulphate which, according to former experiments, easily crystallises.

Hyposulphate of thallium, $TlOS_2O_5$, crystallises in an anhydrous state like the corresponding potash salt; is readily soluble in water, and is deposited upon quick evaporation in agglomerated, tabular crystals, and by slow evaporation over sulphuric acid in single, glassy crystals. I have, however, obtained none which permitted sufficiently accurate measurement. But, in spite of the outward difference in the form of hyposulphate of potash, its isomorphism appears not improbable to me, except that crystals of salts of thallium are hemimorphous and hemihedric. By the employment of a somewhat greater quantity of salt I hope to get more definite crystals.

I tried to prepare a double salt of thallium with hyposulphates of nickel, in order to test, by experiment, the newly-raised question upon the existence or non-existence of double salts of hyposulphuric acid. In fact, by spontaneous evaporation of a very concentrated solution of both salts, we get long shining needles matted together like felt. Notwithstanding their invariably different appearance, there seems to be no definite com-

bination, for the amount of nickel contained in them is too insignificant.

I estimated the loss which the hyposulphate of thallium suffered when heated from 100° — 110° to a faint red heat. The first loss, at 110° , was only 0.003 upon 0.535 grm. of substance, and was hygroscopic water. The loss at a red heat was $0.062 = 11.7$ per cent. The calculation required 11.3 per cent.

Carbonate of Oxide of Thallium.—Although this salt has already been sufficiently analysed and described by Crookes and Lamy, yet I have made it the object of my inquiries, principally in order to ascertain whether, by any means, a bicarbonate may be produced to which may be attributed the peculiar behaviour towards turmeric paper observed by Erdmann.

All attempts to obtain a bicarbonate in a solid form have been fruitless. I have treated the hot and concentrated solution of the metal oxidised in the air with a stream of washed carbonic acid, so that during its cooling a quantity of crystalline needles appeared. (I.) These were the simple carbonate. Then the salt from the mother liquor, which was neutral to turmeric paper, was obtained, once by precipitation with spirits of wine; (II.) another time it was slowly evaporated under the air-pump, when crystals in the form of long broad leaves were deposited; (III.) and a third time the crystals were freed by weak pressure from the remaining solution of the carbonate. (IV.) The crystals immediately became simple carbonate, which, upon decomposition in the carbonic apparatus, gave the following results:—

Grm.			
I.	0.9885	lost 0.093 CO_2	= 9.4 p.c.
II.	1.54	,, 0.152 ,,	= 9.87 ,,
III.	1.21	,, 0.1125 ,,	= 9.29 ,,
IV.	0.552	,, 0.056 ,,	= 10.14 ,,

(This is on the supposition that the atomic weight $Tl = 204$, although I have already mentioned that it must be placed lower, perhaps at 203.5 or 203.7.)

Finally I tried to prove the presence of a bicarbonate existing in solution through the analysis of a neutral solution which did not react upon turmeric paper. When, however, in order to remove the remaining free carbonic acid, I first traversed the solution with a stream of cold air, it was no longer indifferent neutral to turmeric paper, but browned it. In short, it is possible to infer the existence of a bicarbonate from the reaction with turmeric, but it does not admit of proof; for the bicarbonate, if it exist, is very easily decomposed. A very small quantity of weak alcohol will do it, or perhaps, plenty of water alone. When, for instance, we place the aqueous solution of the salt treated with a considerable excess of carbonic acid which is neutral to turmeric paper, with an alcoholic solution of turmeric, no change of colour is at first observable, but browning soon commences, continues for days, and, as far as I have observed, it only begins to grow pale after five or six days. The turmeric paper wetted with solution of carbonate which remains yellow becomes brown when quickly dried. Erdmann observed that exposure to the air produced the same effect. By subsequent treatment with carbonic acid it again becomes yellow, then, if boiled in water, brown again, and so forth. But the appearances are totally different as regards turmeric when treated with a solution of oxide of thallium or of the carbonate mixed with it (having such an alkaline reaction). If we mark with this liquid upon turmeric paper and moisten the spots, they brown immediately, but pale again shortly. If we moisten the places which have grown dry the brown colour reappears, but sometimes not, and

seldom after a second drying. Turmeric paper thoroughly soaked with a solution of oxide of thallium behaves in the same manner. If we hold a paper, bleached as above, over ammonia, or soak it in solution of carbonate of soda no brown colour reappears. In a word, the turmeric dye is destroyed. I sought to explain this phenomenon by the assumption that, as oxide of thallium is easily changed to peroxide of thallium in the open air—more easily than we generally suppose—the oxygen becomes ozonised during this peroxidation, and destroys the colouring matter. But I have never succeeded, even with the closest observation of the process, in detecting the supposed peroxide, for when a bleached turmeric paper is heated with weak sulphuric acid nothing but protoxide of thallium can be detected in the solution by iodide of potassium. If we accept this hypothesis we must adopt the, not improbable, supposition that immediately after its production, whether through a part of the ozone or of the peroxide of hydrogen originating from it, or whether through the organic matter present, the oxide is reduced. It does not to me appear necessary to adopt this explanation, for oxide of thallium in solution likewise destroys turmeric. For instance, if we mix a solution of oxide of thallium with an alcoholic solution of this dye, browning commences, but after a few minutes it grows pale, and then the yellow colour can be induced in the residue by weak acid, or the original brown colour can be restored by alkali.

Concerning the properties of carbonate of oxide of thallium observed by Lamy, I have corroborated Crookes' (*Journ. Chem. Soc.*, April, 1864) observation that a solution super-saturated with carbonic acid leaves behind by evaporation in the water bath a perfectly white crystallised salt, and that no yellowish brown particles are found among them. If, however, the solution contains some hydrated oxide the same solution changes by evaporation into brown oxide. When heated the salt partially decomposes and melts to a gray mass, according to Lamy, or, as I have found, for the most part, to a brownish mass. But we are surprised that Lamy should have troubled himself to define the specific gravity of this mass, as it always contains portions more or less considerable of brown oxide. It is only soluble to a small extent in water, and the solution in acids plainly shows the existence of peroxide when treated with reagents (ammonia, iodide of potassium, etc.).—*Journ. fur Prakt. Chemie*, xcii., 351.

On Tasmanite, a New Mineral of Organic Origin, by A. H. CHURCH, M.A., Professor of Chemistry, R.A. College, Cirencester.

THIS mineral occurs in a laminated shale from the river Mersey, north side of Tasmania. It was exhibited in 1862 as "resiniferous shale" by the Dysodile Company in the Tasmanian Court of the International Exhibition. The shale contains from 30 to 40 per cent. of a yellowish brown combustible matter, which occurs in small discs, marked with a few ridges.* These discs may be separated from the inorganic portion of the mineral by crushing it to a coarse powder, and pouring strong hydrochloric acid over it, when the discs become liberated, and float to the surface of the liquid, the density of which should have been increased by the addition of chloride of calcium to it. The organic mineral thus separated is repeatedly washed with water and then dried at 100°;

it still contains from 8 to 12 per cent. of inorganic impurities, chiefly a silicate of alumina.

The density of the discs is about 1.18; hardness 2; fracture conchoidal; and lustre resinous. They are unaffected by hydrochloric acid, carbonised with evolution of much sulphurous anhydride by sulphuric acid, while nitric acid slowly oxidises them. They are insoluble in alkalies, and in ether, bisulphide of carbon, turpentine, alcohol, benzole, and other similar liquids. Submitted to destructive distillation, tasmanite (the name given to the new mineral) gives oily and solid products, the odour of which recalls that of some specimens of Canadian petroleum.

The most characteristic point in the composition of the mineral is the great amount of sulphur it contains—not in combination with a metal, as in pyritic coal, but in intimate union with the carbon and hydrogen of the organic matter itself. The analysis of the mineral led to the following results, when allowance was made for the ash:—

Carbon	.	.	.	.	79.34
Hydrogen	.	.	.	.	10.41
Sulphur	.	.	.	.	5.32
Oxygen	.	.	.	.	4.93
					100.00

These numbers accord well with the expression—



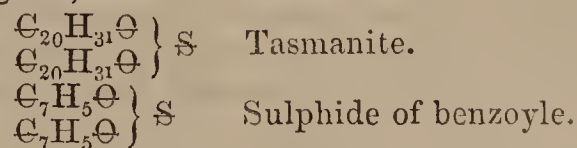
as may be thus seen:—

Experiment.			Theory, $C_{40}H_{62}O_2S$.
Carbon	.	79.34	79.20
Hydrogen	.	10.41	10.24
Sulphur	.	5.32	5.28
Oxygen	.	4.94	5.28
			100.00

Tasmanite may be viewed as the sulphide of an oxidised radical homologous with benzoyl—



which may be regarded as the radical of tasmanite (and of retinite too, to which the formula $C_{40}H_{62}O_4$ has been before assigned):—



Tasmanite and retinite may be derived from a turpentine— $C_{40}H_{64}$.

Notes on the Platinum Metals and their Separation from Each Other, by M. C. LEA, Philadelphia.

PART I.†

FEW branches of inorganic chemistry present difficulties comparable with those involved in the study and separation of the platinum metals. Their close analogy with each other, and the remarkable manner in which the relation of each to chemical reagents are controlled by the presence of the others, give rise to difficulties in their detection and separation, which are only by degrees being surmounted. Much time and unwearied labour on the part of the chemist are required to reach results, which, when obtained, appear insignificant in proportion to the effort which they cost, and it may, in fact, be said that the platinum metals constitute a chemistry in themselves, governed by special rules, and to be studied by special methods: each step in the simplification of the

* Figures of these discs, and full analytical details, will be found in *Phil. Mag.* for December.

† *Am. Journ. Science and Arts*, No. 112, Vol. xxxviii.

processes by which the separations are effected, each decisive reaction by which the presence or absence of a member of the group may be certainly inferred, is so much gained towards conquering a complete knowledge of these rare and interesting bodies.

For much the better half of all we know upon this subject we are indebted to Dr. Claus, whose method of separation I have followed up to a certain point, and then have diverged from it, with, I think, some advantage. I propose to introduce the use of oxalic acid as an agent in effecting the separation in the manner which I shall presently describe.

From my friends, Professor Booth, of the United States Mint, and Mr. Garrett, I received the material upon which I have worked. This was Californian osmiridium, which had already undergone a preliminary fusion with nitre and caustic potash.

This material was next boiled with aqua regia to extract all the soluble portions, the residue was then ignited with nitre and caustic soda,† the fused mass was heated with water. From the resulting solution small portions of osmite of potash crystallised out. The metallic oxides were next precipitated, and in this precipitate, together with the portions insoluble in water, was boiled again with aqua regia, ignited again, &c. These ignitions, in addition to that which it had undergone before coming into my hands, still left a small portion of unattacked residue.

The boiling with aqua regia was continued for a long time, in order to get rid as thoroughly as possible of the osmic acid; in all this treatment was extended over 200 hours. Even this, however, still left osmium in the solution in easily recognisable, but in comparatively small, quantity. The greatest advantage was found throughout the whole of this part of the operation from the use of the blowing apparatus which I described in a former number of the *American Journal of Science and Arts*, and with the aid of which all inconvenience from the fumes of osmic acid was avoided. The apparatus was constantly swept clear by a powerful air current, and the osmic acid was removed as fast as it volatilised. The treatment which the ore had undergone before it was placed in my hand had removed the greater part of the osmium; a portion of what remained had separated out as osmite of potash, and it was not deemed worth while to attempt to save the little that remained. It would be easy, however, in operating upon fresh material with the aid of this blowing apparatus, to conduct the osmic fumes through an appropriate reducing agent, and at the same time to sweep out every trace which escaped reduction. As the ignition of the ore with alkaline nitrate and caustic scarcely drives off any osmium, and as almost all inconvenience in manipulating the resulting solutions can be avoided by throwing down the metals with alcohol from the hot alkaline solution, in place of using acid, it is clear that the difficulties arising from the noxious effects of osmic acid can be almost wholly removed from each of the various stages of the process.

A very prolonged treatment with aqua regia was found to have the great advantage of converting nearly the whole of the ruthenium into bichloride. The separation of ruthenium in this form from the other metals is so easy in comparison with the difficulties presented

by the separation of the sesquichloride, that this advantage cannot be looked upon as other than a very material one.

Sal ammoniac was next added to the mixed solution in quantity sufficient to saturate it. The sandy crystalline precipitate (A) was thoroughly washed out, first with saturated, and then with dilute sal ammoniac solution. The saturated solution of ammonium salt carried through with it nearly the whole of the ruthenium as bichloride (B), the dilute solution was found to contain small quantities of iridium, rhodium, and ruthenium, (C).

Over (A), water acidulated with chlorhydric acid was placed, and allowed to stand for some days. This was treated with ammonia and boiled. The precipitate was inconsiderable, and, when treated with chlorhydric acid, furnished green chloride of osmium, with traces of ruthenium.

In these preliminary steps I have used Claus' process, which undoubtedly offers advantages over any other, and best brings the metals into a convenient state for separation, varying it only by prolonging the treatment with aqua regia, and converting the ruthenium principally into bichloride instead of sesquichloride.

We have now three portions of material, (A) consisting of iridium, sal ammoniac, containing also ruthenium, osmium, rhodium, and platinum in small quantities. The ore which I examined contained no palladium, which metal, if present, has always its own peculiar mode of separation, and does not enhance the difficulties of operation. (B) containing bichloride of ruthenium, together with iron in quantity, copper, and other base metals which may be present. Finally (C), containing chiefly bichloride of ruthenium, mixed with small quantities of iridium and rhodium.

The next step in the process is to introduce the iridium sal ammoniac (A) into a large flask with twenty to twenty-five times its weight of water, and apply heat until the solution is brought to the boiling point; the whole of the iridium sal ammoniac should be brought into solution in order that the reduction to be operated may not occupy too long a time, as otherwise the platinum and ruthenium salt, if any be present, might likewise be attacked. Crystals of oxalic acid are thrown in as soon as the solution actually boils, whereupon a lively effervescence takes place, and the iridium salt is rapidly reduced. As fast as the effervescence subsides, more oxalic acid is added until further additions cease to produce any effect. When this is the case, the liquid is allowed to boil for two or three minutes longer, not more; the heat is to be removed, and the flask plunged into cold water.

By this treatment any platinum present is unaffected. Sal ammoniac in crystals is added, about half enough to saturate the quantity of water present. The sal ammoniac may be added immediately before the flask is removed from the fire. After cooling, the solution should be left for a few days in a shallow basin, whereby the platinum sal ammoniac will separate out as a yellow, a reddish, or even (especially if the quantity of water used was insufficient) as a black crystalline powder, according to the quantity of bichloride of iridium which it may contain.

The mother water is to be again placed in a flask, and boiled with aqua regia. On cooling the platinum sal ammoniac crystallises out, and any traces of rhodium and ruthenium which may be present remain in solution. The iridium salt is to be washed with a mixture of two parts saturated solution of sal ammoniac and three parts of water, and may then be regarded as pure.

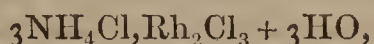
The treatment by oxalic acid, which is now proposed

† Attention is necessary to the order in which these substances are employed. If the caustic soda is melted first, it attacks the iron vessel strongly, and may even go through. If added last it causes sudden and violent effervescence, with danger of boiling over. Therefore, place the nitre first in the vessel and when it is fused add the caustic soda. When a red heat is obtained add the osmiridium by degrees.

for the first time, affords iridium free from all traces of ruthenium. The detection of very small quantities of ruthenium in presence of much iridium has been hitherto an impossibility, or could only be effected by Claus' method of allowing a small quantity of water acidulated by chlorhydric acid to remain in contact with the iridium sal ammoniac for some days. The ruthenium salt, by its superior solubility, tended to dissolve first; hence the acidulated water, after standing, contained ruthenium in larger relative proportion than the original crystals; the ruthenium reactions were more marked, and if it was present, and in sufficient quantity, it could be detected by sulphocyanide of potassium, or better, to an experienced eye, by acetate of lead. The objections to this method are sufficiently obvious. I shall presently describe a reaction which will detect ruthenium in the presence of any quantity of iridium, and, scrutinised by that test, the iridium prepared in the manner which I have just described is free from ruthenium, as well as from the other more easily separable cognate metals.

The treatment of solutions (B) and (C) presents no difficulty. With (B) the best plan is to place the solution aside in a beaker covered with filter paper for some time. Treated in this way, the bichloride gradually crystallises out, and by recrystallisations may be obtained in a state of perfect purity.

Solution (C) is to be evaporated to dryness, and reduced to an impalpable powder. It is then to be thrown upon a filter, and thoroughly washed with a perfectly saturated solution of sal ammoniac. The bichloride of ruthenium is thus carried through, with perhaps a trace of sesquichloride of rhodium, from which, however, it is easily freed by crystallisation. From the residue, the sesquichloride of rhodium and ammonium—

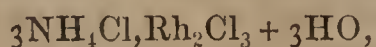


is removed by a dilute solution of sal ammoniac, perfectly free from the iridium, which is left behind.

In connexion with this separation, I may make a remark, which, though of special reference to this particular case, is also applicable to all those cases in which the double chlorides of the platinum metals are to be separated by their various solubilities in solution of sal ammoniac. This most valuable process, in which we are indebted, as for so much else, to Claus, whose untiring labours have made him the father of this department of chemistry, requires to be applied with some attention to minutiae.

The crystalline matter must be reduced to the finest powder, and after being thrown upon the filter, it must be washed continuously until the separation is effected. Any interruption of the washing is followed by more or less crystallisation of sal ammoniac through the material, which precludes an effectual separation. The same material which in a state of coarse powder will hardly yield up enough RuCl_2 to colour the sal ammoniac solution, will, when thoroughly pulverised, give an almost opaque blood red filtrate.

Solution (C) may be subjected to a different treatment from the foregoing, and oxalic acid may be used to effect the separation. The solution is to be brought to the boiling point, and oxalic acid added as long as effervescence is produced. The bichloride of iridium is thereby reduced, the bichloride of ruthenium and the sesquichloride of rhodium are not affected. Sal ammoniac is then to be dissolved in the solution to thorough saturation. By standing and repose the double chloride of rhodium and ammonium—



separates out. The solution is then re-oxidised by boiling with aqua regia; by standing for some days in a cool place, the iridium sal ammoniac crystallises out, and the supernatant solution contains double chloride of ammonium and bichloride of ruthenium, which may be rendered pure by several re-crystallisations.

For purifying the double chloride of iridium and ammonium, $\text{NH}_4\text{Cl}, \text{IrCl}_2$, I give a decided preference to the method which I have described with oxalic acid. It is simple and less trouble, and there is the further advantage that the platinum is left in the condition of double chloride, whereas when the usual method of treating with aqueous sulphuretted hydrogen is used, the platinum is apt to be converted partly into sulphide, together with any traces of rhodium and ruthenium which may be present. When oxalic acid is used, the platinum remains behind as a reddish powder, containing some iridium, from which it may be freed in the ordinary manner, if it is present in quantity sufficient to be worth working.

For treating a mixture such as that which I have here designated as (C), containing no platinum and ruthenium only as $\text{NH}_4\text{Cl}, \text{RuCl}_2$, it is unnecessary to apply reducing agents, and the first method which I have described is the best. But if it be proposed to effect the separation by the reduction of the iridium compound, the method which I describe in this paper is preferable to that based on the use of sulphuretted hydrogen even in this case.

The action of oxalic acid on the platinum metals is interesting; its reducing effect upon bichloride of iridium at the boiling point is immediate. On bichloride of ruthenium it seems to have no effect whatever, may be boiled with it for a length of time without sensible result. In a trial made with sesquichloride of ruthenium and ammonium the oxalic acid was boiled with the metallic salt for a considerable time without any apparent effect becoming visible, but by long continued boiling a gradual precipitation took place. When platinum sal ammoniac $\text{NH}_4\text{Cl}, \text{PtCl}_2$, was boiled with oxalic acid, no effect was produced for a considerable time, but gradually the platinum salt diminished in quantity, and the liquid acquired a stronger yellow colour, perhaps owing to formation of soluble platinic oxalate. I was at first in hopes that the treatment with oxalic acid would have furnished a most easy and convenient method of purifying commercial platinum from the iridium always found in it. But the reduction of very small quantities of double bichloride of iridium and ammonium in the presence of a large proportion of the corresponding platinum salt is difficult and slow, and the platinum salt itself is evidently attacked. It is for this reason that at the beginning of this paper I recommended in purifying sal ammoniac to use a sufficient quantity of water to hold all the iridium salt in solution at the boiling point, and to stop the operation as soon as the cessation of effervescence indicated that the action upon the iridium was terminated. The difference between the time of action of the oxalic acid on the two bichlorides is so very wide as to make it perfectly easy, with proper care, to effectually reduce the one without acting upon the other, except where the platinum is present in very large excess.

(To be continued.)

Conversion of Starch into Glucose by Potato Peelings.—Starch paste diluted with water, and digested for ten or twelve hours with raw potato peelings at 45° or 50° C. is, accordingly to Leuch, entirely transformed into glucose.—*Jour. für prakt. Chem.*, bd. xcii. 3. 59.

TECHNICAL CHEMISTRY.

The Preparation of Matches free from Phosphorus.

HIERPE has published* the following receipts for a composition for the heads of matches, and for an igniting surface. That for the matches is as under:—

Chlorate of potash.	4 to 6 parts.
Bichromate of potash	2 „
Ferric oxide	2 „
Strong glue	3 „

Oxide of iron may be replaced by oxide of lead or of manganese. The above preparation will not ignite on sandpaper, but requires a surface specially prepared for it, and the author employs the following on the boxes:

Sulphide of antimony	20 parts.
Bichromate of potash	2 to 4 „
Oxide of iron, lead, or manganese.	4 to 6 „
Glass powder.	2 „
Strong glue or gum	2 to 3 „

Another composition is described by Dr. H. Poltzer.† A solution of sulphate of copper is divided into two equal parts—one is supersaturated with ammonia, the other with hyposulphite of soda. The two solutions are now mixed, and the mixture is briskly stirred. A white coloured powder now deposits, which is a compound, says the author, of hyposulphurous acid with oxide and suboxide of copper, soda, and ammonia. A mixture of this salt with chlorate of potash detonates when struck with a hammer, and when rubbed in a mortar ignites and burns like gunpowder, leaving a black residue.

The above salt the author proposes to use for matches. It is not soluble in water, and the mixture with chlorate of potash is not hygroscopic. The mixture may be made with moist chlorate, and the gum solution, and can be safely dried at 50°C. or higher. It inflames when rubbed on a rough surface, and the temperature developed is sufficiently high to ignite sulphur on the stick.

The only difficulty the author finds is in making the mass coherent: when dried on the stick he found that it would crack and drop off when rubbed. A manufacturer will probably soon overcome this difficulty.

The proportions made use of were one part of the copper salt, and two parts of chlorate mixed in a sieve, and then made into a mass with solution of gum, together with a little glass powder. This mixture was applied to matches dipped in sulphur as usual.

PHARMACY, TOXICOLOGY, &c.

Researches on Spots of Blood.—Determination of their Age, by M. PFAFF. Their Origin, by M. ERPENBECK.

BLOOD spots, as every one knows, are of a beautiful red colour, becoming brown with time. The red colour begins to change from the second day, the spot becomes visibly brown by the third day, and after a few months it is black, with a slight yellowish tinge.

To these well known characteristics M. Pfaff adds others more precise, drawn from the action exercised on these spots by a solution of arsenious acid (containing one grain to two grains of water). The limit set by him is the time taken by the spot to become pale in this solvent, or until its edges are barely distinguishable from the surrounding substance.

When new they dissolve in a few minutes.

* *Polytech. Centralblatt*, 1864, p. 696.

† *Ibid.*, 1863, p. 1642.

When from 1—2 days old, they require	$\frac{1}{4}$ hour to dissolve.
„ 3—8 „ „	$\frac{1}{4}$ — $\frac{1}{2}$ „
„ 2—4 weeks „ „	1—2 „
„ 4—6 months „ „	3—4 „
„ One year and upwards	4—8 „

With the time taken in effecting the solution, the colour of the liquid obtained must be taken into consideration; the new spots giving a red solution, old ones a brown solution.

Chlorine may in this case be useful in the following manner:—

A spot four months old, for instance, requires to be left 3—4 hours in the arsenious liquid, to be reduced to a slight residue of fibrine, but with edges, still perfectly recognisable. By then leaving the spotted substance for an hour in chlorated water, the edges will become quite indistinct.

A spot six months old, having remained four hours in the arsenical liquid, requires two hours in the chlorated water to cause the edges to disappear.

Under the same condition, a spot eight months old requires three hours; a spot more than a year old requires more than five hours, and so on; the older the spots the longer time they require.

For determining the specific odour of blood, M. Erpenbeck believes he can advantageously substitute heat for sulphuric acid; in operating with fresh blood, he lets a few drops fall into a test tube, and heats it by means of a very small flame. The odour is developed directly all humidity is dispelled, and before the blood begins to carbonise; it is very evident during the cooling, and remains for several months in the sealed tube.

Dry blood he dissolves in water, or at least moistens it before exposing it to the action of heat.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on St. Andrew's Day, November 30; on which occasion the President, Major-General Sabine, delivered his usual annual address, and presented the medals awarded by the Society this year.

The Copley Medal was awarded to C. Darwin, Esq., F.R.S., for his important researches in geology, zoology, and vegetable physiology. This gentleman was prevented from attending by sickness.

The Royal Medal was presented to Warren de la Rue, Esq., for his observations on the total eclipse of the sun in 1860, and for his improvements in astronomical photography.

Another Royal Medal was presented to Mr. Jacob Lockhart Clarke for his researches on the intimate structure of the spinal cord and brain.

The Rumford Medal was presented to Professor John Tyndall, F.R.S., for his researches on the absorption and radiation of heat by gases and vapours.

We quote a portion of the learned President's address relating to Professor Tyndall's researches:—

“Previously to the researches of Professor Tyndall hardly anything had been done in the way of an experimental determination of the absorption of radiant heat by gases and vapours. Melloni had inferred from his experiments that atmospheric air is sensibly diathermanous in a length such as that of an ordinary room, while Dr. Franz came to the conclusion that a column of air only three feet long absorbed more than three and a-half per cent. of the heat-rays from an argand lamp. The discrepancy of these results gives some view of the difficulty of the experiments; but it is only by the perusal of the earlier part of

Professor Tyndall's first memoir on the subject that the skill and patience can be appreciated with which the various sources of error were one by one detected and eliminated by him."

After referring to Professor Tyndall's memoirs, General Sabine remarked:—

"It may serve to show the difficulties which beset the inquiry, arising from the interference of disturbing causes, to state that two such experienced physicists as Professor Tyndall and Professor Magnus of Berlin should have arrived at, and long maintained, opposite conclusions respecting the absorption of radiant heat by air, and the influence of aqueous vapour. This led Professor Tyndall, in a third memoir, to consider more especially the case of aqueous vapour, which he had already treated in his two former papers. The result is that his conclusions have been so confirmed by a system of checks and counter-checks, and by the complete harmony which they present with what we know to be true in other cases, that it seems impossible to doubt their correctness.

"The conclusion that the chief absorbing action of the atmosphere on non-luminous heat is due to the aqueous vapour which it contains has numerous and important bearings on meteorology, and has been applied by Professor Tyndall to the explanation of some phenomena which appear hitherto to have been imperfectly understood.

"In a fifth memoir, which may be expected to be published in a few days, he examines, among other things, the penetrative power of the heat radiated from various flames, and shows that such heat is absorbed with especial facility by the gases which result from the combustion.

"Professor Tyndall concludes from his researches that, as a general rule, the opacity of a substance with respect to radiant heat from a source of comparatively low temperature increases with the chemical complexity of its molecule; and he has given some remarkable instances in which the law is found to be true. Whatever may be thought of our ability to explain the law in the present state of our knowledge respecting the molecular constitution of bodies, the law itself is in any case highly remarkable."

CHEMICAL SOCIETY.

Thursday, December 1.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President, in the Chair.

THE minutes of the previous meeting were read and confirmed, and several donations to the Society's library formally acknowledged. Mr. M. Carteighe, 172, New Bond Street, was admitted a Fellow of the Society, and the following gentlemen were balloted for and duly elected Fellows of the Society, viz.:—Clayton S. Beauchamp, Lieutenant Royal Engineers; Mr. John Bray, High Street, Sheerness; Mr. Charles Ekin, Bath; Mr. Henry Haywood, Broomhall Park, Sheffield; Lieutenant H. M. Hozier, 2nd Life Guards, Topographical Department, New Street, Spring Gardens; Mr. Daniel Harmer Jay, Frog Island, Leicester; Mr. Joseph F. Paine, M.A., Magdalen College, Oxford; Mr. J. G. F. Richardson, Manufacturing Chemist, Leicester; Mr. W. W. Rouch, Norfolk Street, Strand; Lieut.-Colonel H. Y. D. Scott, Royal Engineers, South Kensington Museum; Mr. J. Berger Spence, Newton Heath, near Manchester; Hermann Sprengel, Ph.D., Chemical Works, Kennington Common; and Mr. Alfred Phythian Turner, 3, Upper Baker Street, London. The names of Mr. Alfred Noble, Bristol, and Mr. J. Carter Bell, Manchester, were proposed for the first time, and that of Mr. Alexander Y. Stuart, Apothecaries' Hall, London, for the first time.

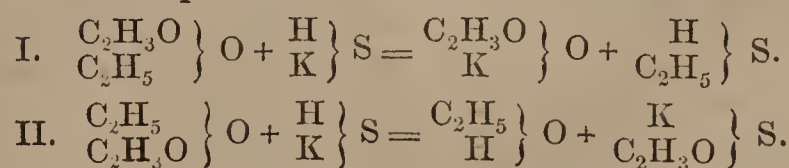
The PRESIDENT then announced the names of nine members who had allowed their subscriptions to the Society to lapse for a number of years, and whom it was

now proposed by the Council to remove from the list of Fellows. He then called upon Professor Redwood to read from the bye-laws of the Society those which were applicable in such a case, and took the sense of the meeting as to whether the ballot should be taken separately or collectively. The latter course having been decided upon, the result of the ballot was favourable to the proposition made by the Council, and the nine members were accordingly struck off the list.

Dr. MARCET was then invited by the President to favour the Society with a further communication upon the same subject as that upon which he had addressed the Society at its last meeting. The paper was entitled a "*Note on the Distribution of Albumen through Muscular Tissue.*" Dr. Marcet commenced by recapitulating the conclusions which he advanced at the last meeting, and referred to Professor Graham's objection to his statement in regard to the diffusibility of albumen. Having made further experiments in the interim, and adopted certain suggestions offered by the great author of "*Dialysis*," he was now prepared to modify to some extent his original conclusions, and would at once proceed to describe the facts which he had recently ascertained. The delicate membrane which covers the sheep's liver could easily be detached by macerating the entire organ in water; this was then carefully cemented to the lower edge of the glass cylinder to form a dialyser, and on filling this with water for the purpose of testing its porosity, it was discovered that minute specks of liquid made themselves apparent after twenty minutes on the lower surface of the septum. At the end of four hours these had accumulated so as to form a drop, then a second, and the third drop fell one hour and a-half after the second. The natural membrane was therefore, to a slight extent, permeable by water. The dialyser was then charged with an aqueous extract of flesh, and left for seventeen hours immersed in water; at the expiration of this time it was found by analysis that 32 per cent. of the albumen in the fluid extract had passed through the diaphragm, and on comparing this with the actual diminution in the bulk of liquid, it was ascertained that the amounts of water and albumen were directly proportional, or, in other words, that the albumen and water had passed through in equal degrees, and hence the passage of albumen must be attributed to the existence of sensible apertures, or pores, through which the entire liquid diffuses itself mechanically. The whole liver and sections of the organ were then employed as dialysers, and gave results generally in accordance with the foregoing, but less albumen diffused through, and the perfect organ was found to be four times more efficacious than the prepared section of liver. Reviewing the whole of the facts, the author was compelled to adopt the conclusion that the appearance of albumen in the diffusate was due to its physical distribution, and was not a true case of diffusion.

The PRESIDENT, in proposing a vote of thanks to Dr. Marcet, took occasion to point out the advantages which often arise out of discussion. If the suggestions offered during the discussion could be put to the test of experiment and the results reported at a subsequent meeting, as in the present case, the data would be the more valuable and reliable.

Professor WANKLYN then read a "*Note on the Action of Sulph-hydrate of Potassium upon Acetic Ether.*" The author had made experiments with the view of determining the constitution of acetic ether by ascertaining the nature of the action exerted by sulphur compounds. Two reactions were possible:—



And the question at issue would be answered by the nature of the sulphuretted product, either mercaptan or thiacetate

of potash would be formed. The older view, according to which acetic ether is regarded as the acetate of ethyl, was said to require the production of mercaptan, whilst the new theory lately advocated by Professor Wanklyn would receive support by the formation of the thiacetate of potash, and in this case acetic ether must be considered as the ethylate of acetyl. The two ingredients were heated together in sealed tubes, alcohol being employed as the solvent for the sulph-hydrate of potassium, and upon breaking open the tubes there was evidence of much sulphuretted hydrogen having been liberated, but no mercaptan had been formed. The liquid required a considerable quantity of sulphuric acid to neutralise it, and was tested for the purpose of identifying the thiacetate, but the author appeared to entertain a doubt whether the last-named substance had actually been formed, and preferred to rely upon the non-formation of mercaptan as his strong argument.

The PRESIDENT understood the author to rely upon this reaction as proving that acetic ether had the constitution indicated by the name of "ethylate of acetyl;" but for his own part he could not see that the non-formation of mercaptan was unfavourable to the old view, or that according to which it was called the acetate of ethyl.

Dr. A. W. HOFMANN assumed (correctly) that the alcohol employed by Professor Wanklyn in his experiment was not absolute, but that it contained about ten per cent. of water. Under these circumstances it was necessary to know whether mercaptan could exert any action upon aqueous acetate of potassium.

Professor WANKLYN had tried the hexylic mercaptan, but not the ordinary ethyl-mercaptan. In the first case there was no reaction exerted between it and the alkaline acetate.

Dr. FRANKLAND considered the author's experiments inconclusive; it was not definitely asserted whether thiacetate of potash had been formed.

Professor WANKLYN explained that caustic potash saponified acetic ether with great facility, but the sulph-hydrate of potassium did not act at all, or only slowly at a high temperature. According to the old view regarding the constitution of acetic ether the formation of mercaptan was imperatively required.

Dr. ODLING pushed the argument further until it broke down under a want of unanimity on some radical points in the atomic theory and the *modus operandi* of double decomposition.

Professor A. H. CHURCH made some additions to his former communication "*On the Density of Certain Minerals.*" With respect to the increase of density in zircons after ignition, it does not invariably take place, and is often quite inconsiderable. The following list gives the density of several zircons before and after ignition: the specimens were from four localities:—

	Density before ignition.	Density after ignition.
Green River, Henderson Co., North Carolina	4.515	4.540
Ditto ditto	4.667	4.667
Espailly, France	4.863	4.863
Laurvig, Norway	4.658	4.707
Fredericksvärn, Norway	4.489	4.633
" "	4.395	4.438

Mr. Church found that there are two stages in the heating of gadolinite, another mineral the density of which augments upon ignition. In the first stage, the mineral at a low red heat parts with some water; but its density is but slightly increased, and its chemical and physical characters are scarcely affected: in the second stage, at an increased temperature, the mineral becomes phosphorescent, loses its colour, acquires a splintery instead of a conchoidal fracture, and also becomes insoluble in acids.

Density before ignition	4.223
Density after gentle ignition and before phosphorescence	4.275
Density after intense ignition and phosphorescence	4.356

With reference to the garnet beads obtained by fusing Arendal iron-garnet, and referred to in his former paper, Mr. Church finds that they showed, after the lapse of six weeks, no sign of return to the higher density of native garnet—

Density one hour after fusion	3.401
Density six weeks after fusion	3.399

These numbers are practically identical. If a mass of garnet be fused in a platinum cage, it will be observed to bulge out at the moment of fusion between the bars of the cage. Mr. Church concludes from this experiment that the density of garnet is lowered at the moment of fusion. All the density determinations recorded in Mr. Church's two papers were made at the temperature of 15°.5 C., and by the old method of weighing the mineral first of all in air, and then in water free from air. Each determination was repeated twice or thrice. In no case was recourse had to the untrustworthy displacement methods of ascertaining the density of a solid.

Upon the invitation of the President, Dr. A. W. HOFMANN rose to explain that he was partially bound by a promise made to his colleagues in the Council, that in the event of matter failing them at the present meeting, he would hold himself in readiness to offer a few remarks upon some of his recent researches. Some of his friends had likewise exhibited the same accommodating spirit, and as he felt sure the meeting was not now dependent upon his personal exertions, he would much prefer postponing the few remarks he had intended to offer until the next meeting, by which time he should be able to illustrate his subject by experiments.

The PRESIDENT then called upon Dr. G. W. SEPTIMIUS PIESSE to give an account of a little mechanical invention which he believed would have an interest for chemists.

Dr. PIESSE thereupon exhibited a small instrument of foreign manufacture, called "*La Bouffée.*" This was made usually of ivory or glass and ormolu, and was intended to produce cold by the rapid evaporation of a volatile liquid. Its construction was explained by a sketch, which showed it to be made of a short length of glass tubing held vertically in water or other liquid, and with the top orifice contracted to a narrow jet; then at right angles to this was fitted a similar, but shorter, length of tubing, so directed as to be nearly touching the vertical jet. If, then, a blast of air be blown through the horizontal tube, it would create a partial vacuum, according to a well-known principle, in the upright tube, causing the liquid to rise therein and produce a little fountain; but by the further action of the air-blast, this stream of liquid became diffused ("or puffed") into a cloud of spray, which could be made available either for producing cold or for diffusing perfumed vapours in the atmosphere of an apartment. The action of these instruments was practically exhibited, and appeared to excite much interest. Dr. Piesse considered that the principle would serve, with a more powerful blast, many useful purposes in the laboratory; he found no difficulty in lifting water to the height of a two-feet column by the aid of a bellows blow-pipe, and it had been proposed to use the instrument as a kind of spirometer.

At the next meeting of the Society, on December 15, a paper by Dr. Gladstone and Mr. Holmes will be read, besides that of Dr. Hofmann, and the President promised to give a short discourse "*On Chemical Nomenclature and Notation.*" The meeting was then adjourned.

ACADEMY OF SCIENCES.

November 21.

THE first memoir read was by M. St. Claire Deville "*On the Dissociation of Carbonic Oxide.*" The author's researches merit the fullest attention, and this paper deserves a complete translation, but we give at once an outline of the experiment detailed in this paper. The author observes that when certain bodies are decomposed at a high temperature their elements are disposed to unite again, and consequently peculiar arrangements are necessary to demonstrate the decomposition. The electric spark decomposes a number of bodies, most probably by the great heat developed, and the reason that this decomposition is not followed by a recombination of the separated elements, the author supposes, is that the small amount of gas traversed by the spark is surrounded by a large atmosphere relatively very cold. He endeavoured to procure similar conditions in the following way. He took a porcelain tube and passed it through a furnace which could be raised to a high temperature. The ends of this tube he closed with corks perforated with two holes. Into one of these he fixed glass tubes to convey the carbonic oxide, and carry off the resulting gas, and by the other holes he carried a brass tube through the entire length of the porcelain tube. This brass tube is to convey a continued stream of cold water. A current of dry carbonic oxide is now passed into the porcelain tube, and the gas from the opposite extremity is carried either into baryta water or through potash bulbs. The presence of carbonic acid is detected as soon as the porcelain tube reaches a bright red heat, and a corresponding amount of carbon is deposited on the cold brass tube. M. Deville points out that the mode of experimenting may be adapted for a variety of examinations.

M. Berthelot, in continuation of his last paper, describes *the calorific effects of the decomposition of formic acid*. He first gives a description of the apparatus employed in his experiments, for which we have no space to-day. The results of the experiment our readers know already. M. Berthelot's deductions are important. His experiments show to him that in some decompositions what we may call an excess of heat is disengaged. Whence comes this excess? Two hypotheses, the author says, present themselves. Either (1) there must exist an external source of active force, which is able to determine a combination and furnish the work expended in its production (this action is analogous to that of light in the formation of vegetable substances); or (2) the effects may only result from changes effected in the internal distribution of the systems—that is to say, two systems of molecules endowed with a certain amount of active force may unite and produce, without foreign action, a new arrangement in which the sum of the work shall be negative. The author's theoretical remarks in general defy condensation, and we proceed to some practical illustrations. The calorific properties of formic acid, he says, may throw some light on the production of animal heat. They show, in fact, that without any combustion heat may be produced in living beings. They prove, further, that the amount of heat developed in the decompositions of the principles which living bodies contain, cannot be estimated by the carbonic acid and water formed, although these may give an approximate idea of the amount. There are bodies, like marsh-gas, which in burning produced less heat than their combustible elements; and there are others, like formic acid, which produce considerably more.

M. Pisani continued his papers on Cornish minerals. He now describes *Brochantite*, *Polianite*, and *Luxulianite*, the last-named from the parish in which it was found, Luxulion, near Lostwithiel. The author mentions that the discovery of these and the Cornish minerals he has previously described was made by Mr. Richard Talling.

Brochantite, we should have said, is $\text{Cu}_4\text{S}_3 + \text{Aq}$. Polia-

nite is nearly pure protoxide of manganese, and Luxulianite is a porphyroid granite in which mica is replaced by tourmaline.

M. Berthe presented a note confirming the results obtained by M. Claude Bernard in his experiments with *morphia* and *codeia*.

M. Jullien, manager of the steel manufactory at Lorette, wrote to say that he had completely converted iron into steel by means of graphite. Krupp, he adds, is understood to use nothing else in his factories. Thus, he adds, carbon alone cements iron. Carbonic oxide, he says, will not cement iron. If M. Margueritte obtained anything more in his experiments than blistered iron, it was because his carbonic oxide held carbon in solution; and he adds that if M. Margueritte will analyse the carbonic oxide made in the way he indicates, he will find that it contains more carbon than belongs to the composition of that gas.

NOTICES OF BOOKS.

A Dictionary of Chemistry and the Allied Branches of other Sciences. By HENRY WATTS, B.A., F.C.S. London: Longman and Co. Part xxii.

IN our notice of the last part of this work (p. 238, C. N.) we inadvertently did some injustice to the able editor and principal writer, Mr. Watts, which we are anxious to repair. The entire article on Light was attributed to Dr. Roscoe, which was an error. We were led into this mistake by seeing Dr. Roscoe's initials at the end of the article, but an esteemed correspondent informs us that only the section at the end on the chemical action of light was contributed by Dr. Roscoe. The rest of this excellent article was written by Mr. Watts.

The present part carries the work on from lipyl to magnesium.

A Treatise on Smoky Chimneys; their Cure and Prevention. By F. EDWARDS, jun. London: Hardwicke. 1864.

ONE of the two worst domestic discomforts is said to be a smoky chimney; and it is pleasant to learn that this one, at all events, may be cured or prevented. "The following little treatise," says Mr. Edwards in his preface, "has been prepared with the hope that by its aid any man of education may be able to become fully acquainted with the subject of smoky chimneys, to trace out the cause of any such nuisance with which he may be inconvenienced, and apply to it its most appropriate remedy." The author finds that there may be thirteen causes for a smoky chimney, for each of which he points out the appropriate treatment. For example:—"Cause 1. From a fire-place being too open. Remedy. To contract the size of the fire-place or use a contracted grate."

The cause is not always so simple as in the above case, and the treatment requires to be more scientific, but it will all be found in this book, which we may recommend to the notice of men of education who wish to get up the subject of smoky chimneys and learn how to prevent them.

Bulletin de la Société Chimique de Paris, &c. November, 1864.

THE present number of the *Bulletin* contains no proceedings of the Paris Chemical Society, but is entirely occupied with the usual abstracts from foreign periodicals. With most of these we have been months in advance of our Parisian contemporary.

Journal für Praktische Chemie. November, 1864.

THE greater part of this number is made up of abstracts mainly from the *Comptes Rendus*; but besides these there is a series of papers by Schönbein on the action of oxygen

on various metals, thallium, lead, nickel, cobalt, and bismuth, and another on the circumstances under which oxygen unites with oxidisable materials when water intervenes in the reaction. We shall give abstracts of most of these papers.

The American Journal of Science and Arts. Conducted by Professors SILLIMAN and DANA. November, 1864.

AN announcement on the cover of this journal causes us unfeigned regret, and almost tempts us to break the rule naturally imposed upon us, never in these pages to refer to political matters. The announcement is as follows:—

“To Subscribers,—The *Journal of Science* is finally compelled to yield to the pressure of high prices like other American periodicals. Instead, however, of increasing the subscription-price, the numbers for the coming year will be reduced in size, yet not so as to make them smaller for the money than the best English scientific journals. . . . We ask for the *Journal* the indulgence and continued support of its subscribers, and promise them that the numbers will again be enlarged when the condition of the country permits of it—which time, we believe, is near at hand.

“SILLIMAN AND DANA.”

Every scientific man, whatever his opinions may be, will sympathise with the editors of this valuable journal, and hope that events will justify their belief.

The present number contains an interesting sketch of the life of Heinrich Rose by his pupil, Professor Dana. From this article we are tempted to make some extracts; for the life of such a man as Rose must naturally have an interest to all chemists. Rose was born on August 6, 1795, at Berlin, where his father and grandfather were chemists and pharmacutists. His father died in 1807, leaving a widow and four young sons. Heinrich was intended for a pharmacist, and was studying pharmacy in Dantzic when that city was besieged by the French, and nearly died of typhus, which prevailed in the town. He and his three brothers afterwards served in the campaign of 1815, and Heinrich returned to Berlin in the same year to enter the laboratory of Klaproth. The following year he was engaged in a pharmacy at Mietau, in which town he had the good fortune to make the acquaintance of Grotthus. From Mietau he travelled in 1819 to Stockholm, and gladly accepted the invitation of Berzelius to finish some investigations which he had begun upon the varieties of mica. In Stockholm Rose was joined by Mitscherlich and by his brother Gustav Rose. Rose and Mitscherlich left Stockholm in 1821, and the former proceeded to Kiel, where he took his degree of Ph.D. Here he published his first work. It was in Latin, and on titanium and its compounds with sulphur and oxygen. In 1822 he established himself in Berlin, and in the following year was appointed to the professorship which he held until his death on January 29 of this year.

It is impossible to do more than refer very briefly to the writings of Rose, respecting which the author of the sketch we quote from remarks as follows:—“The writings of Rose consist of his treatise on ‘Analytical Chemistry,’ and of a great number of articles published in the latter volumes of Gilbert’s, and then of Poggendorff’s *Annals*. In considering these writings, it must be remembered that they extend over a period of nearly fifty years. It is difficult to comprehend the circumstances under which works at such a distance of time were composed, to represent to ourselves the state of science previous to their completion. Each of them must be looked at from a different point of view, which is ever changing with the continued advance of science. To judge of them correctly, we must bear in mind what was known at the time when they were written, as well as that which has since been discovered; we must see them neither as they were seen by the contemporaries, nor as they are seen by

those of our own times, but rather as they would be regarded by a contemporary who kept up with the knowledge of the present day.”

The writer then proceeds to notice in their order some of the most important of Rose’s labours, sketching at the same time the previous state of knowledge respecting the various subjects. We cannot follow the writer far in this part, but we give a list of the principal to which Rose devoted himself. His first important work was his investigation of the minerals having the crystalline form of angite, made in the laboratory of Berzelius, in 1820. To this succeeded the researches on titanium, in the progress of which he discovered that rutile, brookite, and anatase, though belonging to different systems of crystallisation, consist essentially of titanous acid, and thus established the first instance of trimorphism in bodies having the same chemical constitution. Several other discoveries of isomeric states of bodies were made in the same course of investigations. A series of papers on the compounds of phosphorus with hydrogen and oxygen form another of Rose’s most important contributions to chemical knowledge. The publication of these extended over twenty years, for it was Rose’s habit to retain a subject in his thoughts for many years, and publish his investigations from time to time, while in the intervals he was occupied with other works. Another subject which long occupied his thoughts was the chemical decompositions produced by water, which he made a study of a most extended character. Next may be mentioned his researches on the Tantalites, which resulted in the discovery of Niobium and Pelopium, the latter of which he subsequently discarded as a separate element.

Throughout his life, Rose was a firm supporter of the atomic system introduced by Berzelius, and his last paper, “*On a New Series of Metallic Oxides*,” published last year, came of some investigations undertaken to confirm the views of Berzelius.

The reputation of Rose will naturally rest upon his great work on analytical chemistry. The first edition (1829) of this work exhibited the earliest attempt at a systematic plan of qualitative analysis. From its first appearance the work was eminently successful, and it has been extended in subsequent editions, until it now forms the most complete treatise on analysis in existence. The last work Rose was engaged upon was an abridgment, for which a number of new experiments were being made. This work is partly printed, and some of the proof-sheets were examined by the author on his death-bed.

Personally, Rose was a most amiable and liberal man. His students and assistants were his friends, and were constantly invited to his house. He never made use of his students to perform the drudgery and routine of his private researches. He seems even to have disliked receiving fees for his instruction. His lectures were illustrated in the simplest manner, and for most of his experiments he required only an ordinary test-tube. His dislike to display gave rise to the story that after his assistant had caused the tarnished spirit-lamps to be brightened, the Professor was found busily employed in restoring them to their former dingy hue. “He could not talk,” he said, “amid so much glitter.” And with this story we must conclude a very bald abstract of Professor Dana’s interesting sketch.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2801. William Lingham Lees, Aston, near Birmingham, Warwickshire, “A new or improved composition or cement for uniting or joining substances together, and for other purposes.”—Petition recorded November 11, 1864.

2827. Charles Esplin, Tyer Street, Lambeth, Surrey, "Improvements in apparatus for regulating the supply of gas."—Petition recorded November 12, 1864.

2839. John Firth, Sheffield, Yorkshire, "Improvements in the manufacture of steel and iron."—Petition recorded November 14, 1864.

2762. Arthur Field, Lambeth Marsh, Surrey, "Improvements in the manufacture of nightlights."—Petition recorded November 7, 1864.

2786. William Edward Newton, Chancery Lane, Middlesex, "An improved filter or press."—A communication from Louis Pierre, Robert de Massay, and Louis Robert de Massay, Rue St. Sebastien, Paris, France.—Petition recorded November 9, 1864.

2794. John McCall, Houndsditch, London, and Bevan George Sloper, Walthamstow, Essex, "Improvements in preserving fresh meat, poultry, game, or fish, and in vessels employed therein."—Petition recorded November 10, 1864.

2800. William Willis, Birmingham, Warwickshire, "Improvements in processes for copying or reproducing by the agency of light drawings, engravings, lithographs, photographs, and written and printed documents."

2806. George Smith, Bradford, Lancashire, "Certain improvements in machinery or apparatus for drying or desiccating materials or substances containing moisture."

2816. Douglas Symonds Sutherland, Great George Street, Westminster, "Improvements in machinery for compressing gunpowder for blasting or other purposes, and in cartridges for blasting."—Petitions recorded November 11, 1864.

2821. Francis Adams Papps, Bow, Middlesex, "Improvements in malt liquors as tonics."—Petition recorded November 12, 1864.

2840. Jacques Jules Renous-Céré, Golden Square, Middlesex, "Improvements in the manufacture of manure."

2842. Michael Henry, Fleet Street, London, "Improvements in the means of, or appliances for treating bodily injuries, affections, and disorders, when atmospheric air is to be excluded from the part affected."—A communication from Jules Guérin, Boulevard St. Martin, Paris, France.—Petition recorded November 14, 1864.

2846. Jean Joseph Moutié, Paris, France, "Improvements in treating benzole or its principal composing hydrocarbons, such as benzine, toluene, or xylene, applicable also to the treatment of other hydrocarbons."

2854. John Rowley, Grosvenor Terrace, Wells Street, Camberwell, Surrey, "Improvements in the manufacture of printer's ink."

2856. Siegerich Christopher Kreeft, Fenchurch Street, London, "Improvements in the manufacture of iron and steel."—A communication from Jacopo Bozza, Naples, Italy.—Petitions recorded November 15, 1864.

2858. Marie Destren, Rue Lamartine, Paris, France, "An improved composition for painting."

2864. William Edward Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of soda."—A communication from Auel Baug, Paris, France.—Petition recorded November 16, 1864.

Invention Protected by the Deposit of Complete Specification.

2927. Francois Pfanhauser, Winsley Street, Middlesex, "An improved process of tanning."

Notices to Proceed.

1815. Edward Young, Oughtibridge, near Sheffield, Yorkshire, "Improvements in drying and calcining iron and other ores."—Petition recorded July 21, 1864.

1827. William Edward Gedge, Wellington Street, Strand, Middlesex, "An improved process or means of decongelating oils." A communication from Eugène Bernard and Eugène Perrin, Faubourg St. Martin, Paris, France.—Petition recorded July 22, 1864.

1833. Dennis Hall, Winsford, Cheshire, and August Ludwig, Roosen, Manchester, Lancashire, "Improvements

in the manufacture of salt."—Petition recorded July 23, 1864.

1920. John Henry Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of glazes or enamels for pottery ware." A communication from Dominique Grosjean, Cossenen, near La Motte, Benoron, France.—Petition recorded August 2, 1864.

1037. Bernard O'Connor, Manchester, Lancashire, "An improved method of making non-inflammable plain and twilled dyed cotton fabrics, called Jeannett's Beetle-twills, rolled shirtings, fancy and striped, and spotted shirtings, and other cotton goods, printed or otherwise, used for lining dresses and making crinolines."—Petition recorded August 4, 1864.

2486. Charles Hastings Collette, Lincoln's Inn Fields, Middlesex, "Improvements in magneto-electric machine." A communication from Theodore Faucheux, Avenue Trudaine, Paris, France.—Petition recorded October 10, 1864.

2479. John Ives Vaughan, Appleton-in-Widnes, Lancashire, "Improvements in the manufacture of resins and resinous substances, and in the apparatus employed therein, parts of such improvements being also applicable to the refining of coal, petroleum, and bone oils, and also paraffine, and analogous acids and hydrocarbons."

2510. Frederick Wilkins, Oxford Street, and Regent Street, both in Middlesex, "Improvements in apparatus for the production of hydrocarbon vapour, and for the application of the same to illuminating or heating purposes."—Petitions recorded October 11, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, December 5.

THE programme of the evening lectures to be delivered at the Sorbonne has just been issued. The literary series commences this evening; the scientific lectures are delivered on Friday evenings. Both courses are open to any one applying for a ticket, which is furnished gratuitously. Among the scientific lectures will be one by M. Payen, on Gas-lighting; one by M. Fernet, on Photography; one by M. Wurtz, on Water; and the last by M. Jamin, on the Magnet.

The Jardin des Plantes has lately received a valuable collection of living animals from South America, including a large Anteater, two species of Rodents new in this country, and a large Puma. Altogether forty-two animals have been presented by MM. Buschental and Lasseau, two French gentlemen settled in Monte Video, but most of them are well known. One of the Rodents, here called *Viscache*, deserves particular mention. It is about the size of a rabbit, and is something like a chinchilla, but has not such beautiful fur. It seems to be a terribly destructive animal, but nature compensates for this by allowing it only to increase very slowly. The mother suckles her offspring for eighteen months, and they do not arrive at maturity before they are four years old. In an agricultural point of view, says M. Milne-Edwards, nothing can be less desirable than the presence of the viscacha in France; but in a zoological point of view they are not without interest, since they belong to a transition type still but imperfectly known.

Another Universal Exhibition will open here on the 1st of March, 1867, and remain open until the 20th of June. This announcement concerns artists more than scientific men, but may perhaps interest some of your readers.

Here is something new from St. Petersburg. On the 1st of last month some experiments were made there with a new method of extinguishing conflagrations. I might have said putting out fires, but that is a phraseology utterly unworthy of a penny-a-liner. The inventor of this method dissolves something in the water which is pumped on the fire, and the solution instantaneously

extinguishes the fire. What the substance is is kept secret at present, and all we are told is that it is a white powder having a strong smell. After the fire was put out, the partially-burned wood, it is said, seemed to be covered with a sort of varnish. Is the "white powder" silicate of soda, do you think? Having in view the difficulty in the way of supplying the solution, the journals here suggest that some should always be kept ready in factories and such places to quench the first violence of the fire, which is afterwards to be completely extinguished by common water.

Among recent inventions of some interest I may mention a lamp for burning petroleum oils which does not require a chimney. The inventor blows currents of air upon the wick by means of an apparatus driven by clockwork, and thus obtains a smokeless flame. The additional cost of this apparatus is soon saved by not breaking any glass chimneys.

At a sitting of the Academy of Sciences at Vienna, on October 20, M. Boué presented a list of all the papers written on the artificial production of minerals. They are for the most part of recent date. From 1721 to 1799 only fifty-five memoirs on this subject were published, while from 1815 to the present year 734 have been published. Most of these are by Frenchmen, among whom Ebelmen and Gaudin are the best known.

You will see by the *Comptes Rendus* that M. Pisani is continuing his account of new Cornish minerals. I am not well acquainted with Cornwall, and I am specially ignorant of the whereabouts of Sostevithiel, which I read here is a parish in Cornouailles, where one of these minerals was found.

All good and intelligent Mussulmen, we suppose, believe that the coffin of Mahomet is suspended in mid air by means of powerful magnets—where, a healthy credulity would never ask. These are trying times for faith. M. Plateau, of Ghent, a correspondent of the Academy, has been at the pains of calculating whether it would be possible by any arrangement of magnets to suspend a magnetised needle in the air in a state of stable equilibrium without any point of support; and he announces with regret (for he says *hélas*) that he finds it utterly impossible. And so the legend falls to the ground where the coffin itself (if it remains) has rested for hundreds of years. Some people in England will smile, I dare say, at the reception of such a paper by the Academy; nevertheless, more ridiculous questions were discussed at the Royal Society not many years ago.

Preserving Bodies.

To the Editor of the CHEMICAL NEWS.

SIR,—Although the subject is foreign to those usually discussed in the CHEMICAL NEWS, you will perhaps allow me to mention that your Paris correspondent is in error when he states that it was Dr. Martin Van Butchell who kept his two dead wives in his bedroom; this was Sir John Price who had the two bodies embalmed, and put them up like two statues one on either side of his bed. Dr. Van Butchell's was a more scientific proceeding. He, with the assistance of two Medical friends, injected his wife so that her lips and cheeks kept a healthy natural colour; replaced her eyes with glass substitutes, and then put her into a box filled with plaster of Paris, leaving only the face exposed. A pane of glass let into the box or coffin-lid allowed the face to be seen. A second wife, as your correspondent states, insisted on the burial of the body. Both these stories will be found in Philarete Chasles' "*Dix-Huitième Siècle en Angleterre*," pp. 63-4, from which book, no doubt, your correspondent quoted.

It is almost unnecessary to add that Dr. Van Butchell was a great celebrity in his day. He was a pupil of John Hunter, and used to ride about London to visit his patients on a horse covered over with coloured spots.

December 3.

I am, &c.

A READER.

Dr. Morgan's Method of Salting Meat.

To the Editor of the CHEMICAL NEWS.

SIR,—In your report of the proceedings of the Chemical Society meeting on November 17, I find you represent me as stating, in reference to Dr. Morgan's plan of salting meat, "that the quantity of salt might be so much diminished that it became unnecessary to wash the meat preparatory to cooking."

I beg to say that I only expressed my belief that such was the purport of Dr. Morgan's paper on this subject. My impression in this respect agreed with that of other gentlemen present; but I now find, upon inquiry, that there is some doubt whether that impression is consistent with the real facts of the case. I am, &c.

BENJ. H. PAUL.

8, Gray's Inn Square.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday evening next, when the following papers will be read:—"Action of Ammonia on Sulpho-chloride of Phosphorus," Messrs. Gladstone and Holmes; "Chemical Nomenclature and Notation," Professor Williamson.

New Disinfectant.—Basic nitrate of bismuth, when applied to suppurating wounds, has been found to remove all smell, and hasten the healing up. It has been employed in scrofulous sores with much success.—*Archiv. de Med. Milit.*, 1863.

Royal Institution of Great Britain.—The following is the syllabus of a course of six lectures (adapted to a juvenile auditory) on "The Chemistry of a Coal," by Edward Frankland, F.R.S., to be delivered at Christmas, commencing December 27:—Subjects of the course: How coal is put together by nature. How coal is taken asunder by man. Difference between powerful and powerless matter. Materials from which coal is formed:—Water, carbonic acid. Elementary constituents of coal:—Carbon, oxygen, hydrogen. The heat of coal:—How coal burns, and what it produces when burnt:—the glowing cinders—the flame—the smoke—the ashes. The light of coal:—Coal-gas—coal-oil—paraffine, &c. The colours obtained from coal:—Mauve, Magenta, &c. Conclusion.

Cooking without Fire.—M. Babinet, of the French Institute, has laid before the Academy the result of his experiments in this direction. His recipe is:—Place your food in a black pot, cover it with a pane of glass, and stand it in the sun. The water soon boils, and the food is said to be of better flavour than if cooked in the ordinary way.

ANSWERS TO CORRESPONDENTS.

* * In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

* * All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

C. M. R. D.—The communication is unsuited, and the enclosure has therefore been returned.

C. Eades.—The *Comptes Rendus* of the date mentioned contain all we know of the subject, but particulars are not given. Perhaps our correspondent can favour us with some hints.

W. J. G.—Sir B. Brodie has shown that the existence of the radicals SO_4 NO_6 , &c., is very probable. It is difficult to say in these days what chemists believe respecting the intimate arrangement of the atoms of a compound body. Nearly every one holds a different opinion, and, of course, each believes his own.

LONDON SEWAGE.

THE "water carriage" system of disposing of the refuse of dwellings being now almost universal in London, and the getting rid of the sewage almost a *fait accompli*, its application as manure involves the consideration of the following questions:—1. What amount of sewage is to be applied to land? 2. Where can it be used? 3. What will be the cost of applying it to the land? and 4. What will be the effect produced by its use as manure?

In answer to the last question, there is the experience gained during many years at Edinburgh, and within a shorter period at Croydon. There are also the results of elaborate and careful experiments made at Rugby by Messrs. Lawes and Gilbert, under the auspices of the Royal Sewage Commission—a *resumé* of which has been given in the CHEMICAL NEWS of April 18, 1863. These have fully confirmed the results obtained at Edinburgh by showing that sewage not only supplied the place of ordinary manure, but produced an increased amount of crop. A further Report of this Commission is expected to appear shortly, and any further reference to these results may, therefore, be deferred till then.

At Croydon the use of sewage was the result of its compulsory exclusion from the river, and the wisdom of that measure has been sufficiently proved by the fact that the sewage which was formerly wasted, has been the means of fertilising and improving 250 acres of land to such an extent that its rent has been increased one-fourth, yielding an income of 250*l.* a-year to the local Board.

At Carlisle similar results have been obtained, and the land to which sewage is applied, has been sublet at an increased rental of about 400*l.* a-year. At Edinburgh, the land to which the sewage is applied was formerly worth only 5*s.* per acre, and is now assessed at 22*l.* per acre; and the grass obtained from it is worth from 20*l.* to 40*l.* per acre yearly.

Between these several instances of the use of sewage as manure, there are some great differences as to the quantities applied per acre, the kind of land, &c., which are worthy of notice.

At Edinburgh, the land to which the sewage is applied is for the most part very inferior, much of it having been originally mere sand, and the improvement of this land must be considered in a great degree due to an actual formation of soil by the gradual deposition of humoid substances by the sewage. Some part of the sewage is applied to land of superior quality, which was originally worth 6*l.* 10*s.* per acre, and now yields 30*l.* per acre. The only crop grown with sewage is Italian rye grass. Only part of Edinburgh being under the "water carriage" system, it is only the refuse from some 80,000 of the population which is disposed of as sewage. This is distributed over rather less than 300 acres of land.

At Carlisle, the land which receives the sewage is sandy and porous, and is altogether meadow land. The sewage from 22,000 of the population is distributed over 70 acres of land.

At Croydon, the sewage from 17000 of the population is distributed over 250 acres of loamy soil, on which Italian rye grass is grown.

At Rugby, the sewage of 8000 of the population was formerly distributed over about 450 acres of loamy soil, generally of a heavy kind; but that practice has been abandoned, and it is now all disposed of on some 12 or 15 acres.

The differences in the character of the land at these places would no doubt have considerable influence in

determining the relative degree of deodorisation effected by the filtration of the sewage through the soil, and the extent of the nuisance arising from its use in the immediate neighbourhood. At Edinburgh the smell from the sewaged land is almost always very offensive; but this may be due in part to the crude mode of application, and in part, also, to the slight absorptive power of the sandy soil, and the large amount of sewage used per acre.

At Croydon, on the contrary, where the land is of a more absorptive nature, it is stated that there is no nuisance arising from the use of the sewage, and that the water flowing away from the land is colourless, inodorous, and tasteless.

Adopting the assumption referred to last week, that the ingredients of sewage valuable as manure, are worth 6*s.* per annum for each individual, the following table will show the proportion between these several instances, as regards the distribution of the sewage:—

	Croydon.	Edinburgh.	Carlisle.	Rugby.
Total value of manure constituents per acre .	£20	£80	£94	£100
Number of population per acre	68	266	314	333

In all these instances the quantity of manure ingredients supplied per acre is very much greater than would be used if they were in a solid state as in guano, or farm-yard manure, &c. And wherever the application of smaller quantities has been attempted, as at Rugby, and by the Earl of Essex, at Watford, that practice has been abandoned, notwithstanding the considerable outlay per acre incurred in laying down pipes for distribution, and the application of sewage has been confined to a very limited area relatively to the quantity of manure constituents. Its use has also been confined to meadow land or Italian rye grass, with merely occasional application, in seasons of drought, to other crops.

These, then, are the indications of experience in the use of sewage. On the other hand, it has been contended that the use of sewage is to be regulated by the amount of manure constituents it contains, quite irrespective of the extreme degree of dilution, and that something like one-thirtieth of the quantity used at Rugby would be sufficient to supply to the land as manure.

It must be remembered that in the several instances of the use of sewage as manure, already referred to, the population of the towns is comparatively small, and that their situation is favourable for disposing of the sewage in that manner; but if the doctrine of applying sewage with the hose and jet, as a mere sprinkling, be correct, or even a remote approximation to the truth, the area of land required would be proportionately increased. At the same time the cost of distribution would be largely increased; and after all, the question would remain, would farmers incur the outlay for this purpose, or would they take sewage at all under the circumstances? The answer to these important questions cannot be derived from the mere opinions of *dilettanti*, enthusiastic on the subject of liquid manure.

But there is a more important consideration to be noticed in connexion with this point, as regards the use of London sewage as manure. The quantity of this material to be dealt with at the places already mentioned is trifling compared with that of the London sewage. Taking, for instance, the case of Edinburgh, where the sewage of the largest population (80,000) is disposed of on some 300 acres of land, 9000 acres would be needed according to the above estimate, and taking the prospective population of London at about 3,000,000, something like 400,000 acres would be required, or about one-sixth

of the entire quantity of land under culture in the whole British Islands. That this conclusion is not exaggerated it may be mentioned that it was stated by one of the witnesses before Lord Robert Montague's committee, that the sewage of London ought to be sufficient for not less than from 500,000 to 600,000 acres of land; and the Coal, Corn, and Finance Committee, in their report to the Common Council of London, quote that statement as having been made by a "competent witness"!!

From this stage, to the notion of London sewage becoming the source of a revenue of some two or three million sterling a year, the passage is easy. With this notion the aldermanic mind seems to be possessed as by a nightmare, and to have become vigorous in denunciation of all contrary opinion. It is, indeed, probable that the coming session of Parliament will show signs of the disturbance to which many stolid and respectable citizens have been subjected by the contemplation of long rows of ciphers, and the immediate proximity of a live Lord. But amidst all these agitating influences, the practical shrewdness of the business man crops out, and the Corporation of London, while vehemently declaiming upon the great value of sewage, does not offer to take its application in hand, though the privilege could no doubt be obtained a bargain; and they expend their efforts in buffeting the Metropolitan Board of Works, for being too precipitate in parting with this treasure, which they fear to lose, but somehow have not courage enough to seize.

Having thus pointed out briefly the general position of the subject at the present time, as regards London, as well as the nature and tendency of the knowledge which has been acquired as to the use of sewage as manure, we purpose in another number to consider the two modes of disposing of London sewage, which have assumed in any degree a tangible form—viz., that of running it down through a covered culvert to sands near the sea-shore in Essex, where it would be disposed of much in the same way as at Edinburgh; and that of pumping it to the top of Hampstead-hill, and distributing it through a system of pipes over any extent of land where it would be received.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Revision of the Mineral Phosphates—No. IV., Calaité—
by A. H. CHURCH, M.A., Professor of Chemistry,
R. A. College, Cirencester.

THE formula of calaité (turquoise) is generally considered doubtful; that the blue colour of fine specimens of this mineral is due to the presence of phosphate of copper in considerable proportion, and that compounds of iron and manganese are also present in small quantities, seems to be allowed. The action of boiling water and of alkalis upon calaité and the use of the permanganate test indicate that in blue specimens of this mineral the cupric oxide is in union with phosphoric anhydride, and not as hydrate, and that the iron exists almost wholly as a ferrous compound. Some green and dull coloured specimens contain evident traces of a ferric compound, however; in the deep blue kinds the percentage of copper is considerably increased.

For the purpose of analysis a pure blue specimen from Nichabour, Persia, was employed. Its hardness was 5.5; its density 2.75. It was subtranslucent. The ex-

terior, being of a paler tint and somewhat softer than the mass of the mineral, was carefully removed.

.675 grm. of calaité lost .0033 grm. H_2O in *vacuo* over sulphuric acid.

.6717 " " " .1287 grm. H_2O on ignition.

" " " gave .005 grm. SiO_2

" " " " .0164 grm. Fe_2O_3

" " " " .0026 grm. Mn_2O_3

" " " " .044 grm. Cu_2O

" " " " .268 grm. Al_2O_3

" " " " .3425 grm. $Mg_3P_2O_7$

These results correspond to the following percentage numbers, silica and hygroscopic water having been deducted:—

	Per cent.		Per cent.
Fe_2O_3	. 2.21	SiO_2	. 74
Mn_2O_3	. 36	Hygroscopic water	. 49
Cu_2O	. 5.27		
Al_2O_3	. 40.19		
P_2O_5	. 32.86		
H_2O	. 19.34		
	100.23		

I have previously shown that there are good reasons for believing the iron, manganese, and copper in calaité to be present as the normal phosphates of the protoxides of those metals. One may, then, regard this mineral as containing several phosphates, or as containing phosphate of aluminium in which a portion of the aluminium has been replaced by the metals just named. In either case it will be a perfectly legitimate process to recalculate the percentages of alumina, phosphoric anhydride, and water, after deduction of the ascertained proportions of the phosphates of iron, copper, &c., present. Assuming $Cu_3PO_4 + aq.$ as the formula of the normal cupric phosphate, and $(FeMn)_3PO_4 + aq.$ as the formula of the manganese-ferrous phosphate, the amounts of metallic oxides found by analysis give the following percentages of their corresponding phosphates:—

	Per cent.
$(FeMn)_3PO_4 + aq.$	. 4.89
$Cu_3PO_4 + aq.$	. 10.47

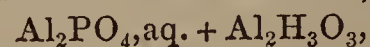
The residual water, alumina, and phosphoric anhydride correspond after these deductions have been made to the following percentage proportions:—

	Per cent.
Al_2O_3	. 32.04
P_2O_5	. 47.11
H_2O	. 20.85
	100.00

On comparing these numbers with the percentages demanded by the simplest formula that suggests itself, a very close and satisfactory approximation will be observed:—

	Experiment.	Theory, $Al_2PO_4 + aq.$ $+ Al_2H_3O_3.$
Al_2O_3	. 32.04	32.45
P_2O_5	. 47.11	46.99
H_2O	. 20.85	20.56
	100.00	100.00

By recalculating, on the same principle, the older analyses of calaité, the conclusion to which my results have led me is further confirmed. The formula,



is no new one, but previous analytical results seemed scarcely to warrant its acceptance; the differences between experiment and theory were too great. The proposed formula requires us, however, to regard the

phosphates of copper, iron, and manganese as intruding salts, not as essential to the constitution of the mineral itself.

A few words as to the analytical methods adopted may not be out of place. From the hydrochloric solution of the ignited mineral the copper was precipitated by a current of hydrosulphuric acid gas; the cupric sulphide obtained was dissolved in nitric acid and weighed as oxide. The filtrate from the copper solution was boiled and oxidised, and then a boiling solution of pure hydrate of potassium added to it in excess. The oxides of iron and manganese remained undissolved; they were washed, ignited, and weighed, their separation being afterwards effected by the use of carbonate of barium, &c. The alumina and the phosphoric acid were subsequently separated by precipitation of the soda solution with pure baryta water, &c.; the alumina was precipitated by sulphide of ammonium.

December 7.

Preparation of Formamide by means of Formiates and Oxalates, by M. LORIN.

ONE of the most usual methods of preparing an amide consists in making ammonia react on the free or nascent acid corresponding to the amide, and then decomposing, by heat, the ammoniacal salt formed. This general method has been applied in several particular instances to formamide. I propose extending its application, and showing once more that the formation of this body is only apparently exceptional.

Formiates.—M. Petersen obtained acetamide by causing hydrochlorate of ammonia to react on acetate of soda; this process serves equally for the production of formamide. With a mixture of equal equivalents of formiate of soda and hydrochlorate of ammonia, assisted by the action of heat, I obtained formamide. The phenomena accompanying the production of this body are identical with those produced by the distillation of formiate of ammonia. I also ascertained that oxide of carbon is produced at the same time, about 12 litres per 100 grammes of formiate, as a secondary product.

Formamide may also be obtained, but not so advantageously, by replacing formiate of soda by formiate of lime, and it is not unlikely that all salts of soda and lime may serve for the preparation of the corresponding amide. However that may be, the reaction of equal proportions of formiate of lime and hydrochlorate of ammonia give results deviating slightly from the preceding—it is, in fact, necessary to raise the temperature; a smaller quantity of gas is disengaged with greater difficulty; and the proportion of formamide produced is relatively less than that obtained with formiate of soda. The gas evolved was a mixture of carbonic oxide and hydrogen, with traces of carbides. Hydrocyanic acid and carbonate of ammonia are also produced. A mixture of formiate of ammonia and chloride of calcium was also tried. In this case also, hydrocyanic acid and carbonate of ammonia are formed, but only a small amount of pure carbonic oxide is evolved. These circumstances, and the rapidity with which the boiling-point of the small quantity of liquid obtained rises, make it probable that formamide is produced in this reaction, though merely in traces.

Oxalates.—Various facts tend to prove the close relation existing between formic and oxalic acids. Among these I will cite that observed by M. Berthelot—the complete transformation of oxalic acid into formic acid and into carbonic acid, under the influence of glycerine, &c.

In confirmation of the proposition, that formamide is generated in the same way as all the other amides, is the existence of this body among the products of the decomposition of oxalates of ammonia, neutral or acid, under the regulated action of heat. Gerhardt, in a research, which was the continuation of a remarkable work by M. Balard on oxamic acid, showed that oxalate of aniline, in decomposing, formed at the same time oxanilide and formanilide.

Following his example, I searched for formamide among the products given by oxalates of ammonia.

I operated on these salts dry and crystallised, neutral or acid. Rejecting the portion of the liquid which was below 130° , in the distillation of each of the liquids obtained, then finishing the distillation under slight pressure, and then drying over sulphuric acid, I at last, after a final distillation in partial vacuum, obtained liquid presenting all the characteristics of formamide. To set aside all doubt as to the existence of this body in these reactions, I purified and treated it as follows:—Shaking it from time to time, I left it for several weeks in contact with pure, dry, powdered carbonate of lead; I filtered it, then decomposed by a current of dry sulphuretted hydrogen; again filtered, and finally distilled in a vacuum, all the previous operations having been made in dry air.

I afterwards estimated the last product obtained by ammonia. I found, moreover, that, under the influence of potash, no oxalic acid was reproduced.

The production of gas and carbonate of ammonia by the regulated distillation of oxalates of ammonia, neutral or acid, accords with the composition of these salts. Though neutral oxalate gives a very considerable quantity of carbonate of ammonia, the acid oxalate gives very little. And, as may be foreseen, the neutral oxalate gives very little gas, and the acid oxalates a considerable quantity.

My results are briefly,—1. Formamide is obtained by distilling a mixture of hydrochlorate of ammonia, and a formiate, especially formiate of soda; 2. To the already numerous bodies produced by the regulated distillation of neutral or acid oxalates of ammonia, formamide must be added.—*Comptes Rendus*, lix., 788. 64.

Researches on Hydrocyanic Acid, by MM. BUSSY and BUIGNET.

HYDROCYANIC acid has been so thoroughly studied by Gay-Lussac; has been, since its discovery, the object of so many remarkable works, that any further researches on this subject may possibly be regarded as superfluous. The subject has been, in a way, forced upon us, having to pass in review, for a new edition of the *Codex*, the various processes for preparing hydrocyanic acid, we were obliged to examine every detail, and especially what concerned the yield. As is frequently the case in researches of this kind, the train of experiments and the necessary explanations have led us to extend our work beyond the limits originally assigned to it.

All chemists know that Gay-Lussac was the first to obtain hydrocyanic acid by a process which is still in use—a sure and easy process, consisting in decomposing cyanide of mercury by hydrochloric acid, passing the product on chloride of calcium and collecting it, thus dried, in a conveniently cool receiver.

But it is not so generally known that the process is by no means satisfactory as to the quantity of the product. If we employ for this preparation 126 grammes of cyanide of mercury, and 109.5 gr., of hydrochloric acid containing

33 per cent. of real acid—quantities which correspond to an equivalent of each of the two substances, and which our experiments have shown to be the most favourable to the yield—we obtain, by following the above process, only about 18 grammes of anhydrous hydrocyanic acid—that is to say, only two-thirds of the theoretical quantity; for, according to the equation— $\text{HgCy} + \text{HCl} = \text{HgCl} + \text{HCy}$,—1 equivalent, or 27 grms., of hydrocyanic acid should be the result.

This difference can be explained neither by the loss of a small quantity of acid which would have escaped condensation nor by the production of a trace of formiate of ammonia, according to the well-known equation— $\text{HC}_2\text{N} + 4\text{HO} = \text{NH}_3, \text{C}_2\text{HO}_3, \text{HO}$.

The missing acid remains entire in the residue, whence it may be extracted by prolonged distillation. But when, during this distillation, the fire is increased, in order to obtain the last traces of the acid, the temperature of the residue gradually rises, even to above 100° , and gradually reaches 110° . Much water and very little acid is then produced; the chloride of calcium liquifies, and it becomes impossible to adhere to the first conditions of the experiment.* It is only by modifying them, as we shall show further on, that the whole of the acid, represented by the cyanide, can be obtained in an anhydrous state.

The obstacle to the disengagement of acid proceeds, in this case, from the affinity of the corrosive sublimate formed—an affinity by reason of which the acid is retained in the solution, from which it can only be separated by a relatively high temperature; hence, consequently, it takes with it a considerable quantity of water. To overcome this difficulty, it occurred to us to add to the other matters an equivalent of hydrochlorate of ammonia, which forms, with the corrosive sublimate, a stable combination, long known as sal alembroth. We supposed that, by this combination, the influence of the corrosive sublimate on the hydrocyanic acid would be destroyed, that the acid would be disengaged at a much lower temperature, taking with it but a very small quantity of water, and that we should thus be enabled to collect the whole of it in an anhydrous state, and without in any way modifying the apparatus. The result has fully confirmed our supposition; and by this means the theoretical quantity of 95 centimes of anhydrous acid is obtainable. The details of the operations have been given in a previous memoir (*Journal de Pharmacie et de Chimie*, xlv., 292).

These observations having revealed to us a special action of the corrosive sublimate on hydrocyanic acid, we wished to complete this study by more precise experiments, and investigated successively the action exercised on water and a certain number of compounds, by hydrocyanic acid. The results described in the present memoir appeared to us to be of sufficient interest in the history of hydrocyanic acid to merit the attention of chemists.—*Annales de Chimie et de Physique*, iii., 231. 64.

TECHNICAL CHEMISTRY.

Use of Petroleum as Steam Fuel in place of Coal, by B. H. PAUL.

SOME months ago considerable interest was excited by the announcement that very remarkable results had been

obtained in America by the application of petroleum as fuel for the boilers of steam vessels, and so much importance was attached to the subject, that a Commission was appointed by the Government of the Northern States to inquire into this application of petroleum.

The report published by the Commission, as the result of their labours, was calculated rather to excite curiosity than to afford satisfactory information, and they have not, so far as I am aware, made public any further data which would afford a means of arriving at an opinion on the subject.

The proposal to use petroleum as steam fuel in ships became, almost of course, a subject of consideration in this country, and an idea prevailed that this invention might possibly supersede in importance all the recent improvements connected with the naval or mercantile marine. It was anticipated that not only naval warfare, but even navigation itself, might be completely revolutionised by this invention. It was reasonable enough that a project put forward with such pretension as was the case in respect to the use of petroleum as fuel for steam vessels, should be considered in a country where every improvement relating to steam navigation is of high importance; but it is surprising that no one should have disabused the public mind of the erroneous impressions produced by the statements as to the use of petroleum as fuel; for to any one conversant with the composition and characters of petroleum, as compared with coal, this proposed application of it was obviously absurd.

Lately little has been heard of this project until some days ago a notice appeared in the *Times*, under the head of "Naval and Military Intelligence," that experiments are being conducted at the Woolwich Dockyard, with the view of testing the capability of petroleum to supersede coal and other fuel on ship-board, &c. In this notice it was stated that the oil was so utilised "as to be equal for steam purposes to five tons of coals"! How much of the oil was equal to five tons of coals was not stated, but it may be fairly supposed that any one unacquainted with the subject would infer that one ton of oil was meant.

Now, what are really the facts of the case as to the comparative advantages of petroleum and coal as fuel?

In the first place, one of the chief alleged advantages of petroleum over coal, was that it would lie in a small compass and make less demand upon space and tonnage than coal does. Since with petroleum in the place of coal, two-thirds of the space now required for fuel in a steam vessel would be saved, steam ships might keep at sea three times as long as at present. Then, coal depôts would be unnecessary for steam packets on the longest lines of ocean navigation; and since no stokers would be needed in using petroleum, a whole army of employes might be dispensed with.

Now, the specific gravity of coal is from 1.24 or 1.44 to 1.6, while that of petroleum is from 0.800 to 0.850, consequently the weight of a cubic foot of these materials would be, respectively, about as follows:—

	lbs.	lbs.	lbs.
Coal . . .	77.4	90	100
Petroleum . . .		50	53

But, since petroleum, being liquid, lies in a more compact manner than coal; in estimating the spaces occupied by these materials, allowance should be made for the interstices or empty spaces between the lumps of coal. Taking this as amounting to one-third of the whole bulk

* This difficulty seems to have been recognised by Gay-Lussac himself, for he recommends that the operation should be stopped directly the water begins to volatilise, and that the residue should be used for preparing an aqueous solution of prussic acid.—*Annales de Chimie et de Physique*, lxxvii. and xcv.

of a heap of coals—which is a liberal allowance—the contents of a cubic foot would be as follows:—

	lbs.	lbs.	lbs.
Coal	52	60	70
Petroleum	50	53	—

So that the spaces occupied by equal weights of coal and petroleum would be about as 1 is to 1.2 or 1.4.

Then the relative heating power of equal weights of coal and petroleum, would depend upon their respective chemical composition, which may be compared as follows for 100 parts:—

	Coal.	Petroleum.
Carbon	83	85
Hydrogen	5	15
Ash, &c. . . .	—	—
	100	100

Accordingly, the relative heating power of equal weights of coal and of petroleum would be in the following ratio:—

	Coal.	Petroleum.
Calorific power	1.02	1.50

And the spaces occupied by quantities of petroleum and of coal, having equal heating power, would be in the ratio of 1 to 1.16.

This difference in favour of petroleum is in itself too small to admit of any advantage being gained in regard to stowage, and it is more than doubtful whether there be any other advantageous difference between petroleum and coal for fuel.

It must also be considered how far the difference between the prices of petroleum and coal would have the effect of neutralising the above, or any other advantage to be gained by the use of petroleum as fuel. The price of petroleum varies from 15*l.* to 20*l.* per ton, while that of coal used for steam vessels is under 1*l.* per ton at any part of the British coast, and even at the coaling stations in the East it does not exceed 2*l.* 10*s.* to 3*l.* 10*s.* per ton.

These considerations alone appear to me to decide the question as to the practicability of using petroleum as steam fuel under any possible circumstances, for even in the case most favourable for the comparison of petroleum with coal, the cost of equal quantities of heat produced from these materials, would be in the ratio of 15*l.* to 4*l.*

In addition to this, the highly inflammable nature of petroleum must be considered. Its storage on board a ship would require the use of air-tight vessels, and even then there might be considerable risk of the production of explosive mixtures of the petroleum vapour and air. But what would be the condition of a vessel of war provided with petroleum as fuel, if a shot penetrated the vessel containing the petroleum, and allowed it to escape in proximity to the boiler fires?

Taking all these circumstances into consideration, I think there cannot be any doubt as to the entire fallacy of supposing that petroleum can be substituted for coal as fuel; and though this conclusion is sufficiently evident from the data I have adopted as to price, &c., it must also be remembered that the tendency is rather to a rise in the price of this commodity than otherwise.

by Professor Forchhammer, of Copenhagen, was read. The number of elements hitherto found in sea-water the author stated to be thirty-one—viz., oxygen, hydrogen, nitrogen in ammonia, carbon in carbonic acid, chlorine, bromine, iodine in fuci, fluorine in combination with calcium, sulphur as sulphuric acid, phosphorus as phosphoric acid, silicium as silica, boron as boracic acid (discovered by the author both in sea-water and in sea-weeds), silver in the *Pocillopora alaicornis*, copper very frequently both in animals and plants of the sea, lead very frequently in marine organisms, zinc principally in sea-plants, cobalt and nickel in sea-plants, iron, manganese, aluminium, magnesium, calcium, strontium, and barium, the latter two as sulphates in fucoid plants, sodium, potassium. These twenty-seven elements the author himself had ascertained to occur in sea-water. The presence of the next four elements—viz., lithium, caesium, rubidium, and arsenic—has been shown by other chemists. Of these elements only a few occur in such quantity that their determination has any notable influence on the quantitative analysis of sea-water—viz., chlorine, sulphuric acid, magnesia, lime, potash, and soda. The others, as far as their existence has been determined in the sea-water itself, are found in the residue which remains after evaporation to dryness and re-dissolution of the salts in water. The author next stated that, in the water of the ocean far from the shores, the principal ingredients always occur very nearly in the same proportions. If we assume chlorine = 100, the mean proportion of the other leading constituents is as follows:—

	Mean proportion.	Maximum.	Minimum.
Sulphuric acid	11.89	12.09	11.65
Lime	2.96	3.16	2.87
Magnesia	11.07	11.28	10.95
All salts	181.1	181.4	180.6

These proportions apply only to specimens obtained at a long distance from shores or in the open ocean. In the interior of the Baltic, for instance, the proportion of chlorine to sulphuric acid is as 100 to 14.97, to lime as 100 to 7.48; and the proportion of chlorine to all salts as 100 to 223.0. This constant proportion of the different constituents in the ocean depends evidently not upon any chemical combination and affinity between the different substances, but upon the enormous quantity of salts in the whole ocean, which renders imperceptible any difference that might otherwise arise from the different proportion in which salts are carried into the sea by rivers. It depends besides on the uniform action of the numberless organic beings inhabiting the ocean, which abstract sulphuric acid, lime, potash, and magnesia from the water, and render them insoluble. The mean quantity of solid matter in the water of the ocean generally the author found to be 34.304 per 1000.

Relative to this paper the PRESIDENT in his annual address made the following observations:—This communication forms a valuable contribution to a great subject—the history of the sea. It contains a full and compendious inquiry into the constituents of the water of the ocean, divided into seventeen geographical regions, each of which is studied separately from samples taken both at the surface and at various depths. An accurate view is thus gained for the first time of the sea as a whole, and conclusions of great generality are obtained. The minute analytical processes followed in several hundred analyses were so conducted as, in the opinion of competent judges, to inspire entire confidence. They confirm the presence in sea-water of the twenty-five elements already reported by other chemists, and add two others, boron and aluminium, to the number. But it is chiefly by the application of the data thus obtained to the elucidation of various geographical problems of great and general interest that we are led to recognise the full importance of this memoir. I may permit myself to notice one or two of the most remarkable of the conclusions established by it. In the Atlantic the saline ingredients in the sea-water (the samples

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY.

November 17 and 24.

Major-General SABINE, President, in the Chair.

On the above two evenings a paper, “On the Constitution of Sea-water at Different Depths and in Different Latitudes,”

being taken at proper distances from the land) decrease with increasing depth. This is found to hold good even to extreme depths. The existence of a polar current in the depths of the Atlantic is hence inferred, since it is a well-established fact that the equatorial seas are richer, and the polar seas poorer, in saline ingredients. The large amount of saline contents found by analysis of the water of the well-known current flowing from north-east to south-west, between Iceland and the east coast of Greenland, shows it to be, not as heretofore supposed, a polar current, but one of equatorial origin. The inference is, that it is a returning branch of the great Gulf-stream, which we have recently had reason to recognise as extending to the shores of Nova Zembla and to the north coasts of Spitzbergen, carrying to Nova Zembla the floats of the Norwegian fishermen, and to Spitzbergen the same floats, mingled with wood from Siberia. May it not be possible that the "iceless sea, teeming with animal life," described by the adventurous American explorer, Dr. Kane, as viewed from the promontory which formed the northern limit of his research, is, as he himself surmised, but an extension of the same equatorial stream which produces correspondingly abnormal effects at Spitzbergen, as well as at every other point to which its course has been traced? When physical researches shall be resumed within the circle which surrounds the Pole, this, perhaps, will be one of the earliest problems to receive solution—a solution rendered now so simple by the method of inquiry which Professor Forchhammer has made known to us.

PHARMACEUTICAL MEETING.

Wednesday, December 3.

Mr. HILLS, Vice-President, in the Chair.

THE first paper read was "*On the Botanical Origin of Gamboge*," by DANIEL HANBURY, Esq., F.L.S. The exact botanical origin of gamboge has long been involved in obscurity, for though it was known to be a plant of the genus *Garcinia*, the species had never been determined. Hermann, who lived in Ceylon in the 17th century, referred the origin to two plants—one now known as *Garcinia Morella*, the other as *G. Cambogia*—and it is stated by Mr. Thwaites that the former yields a good form of the drug, but not the latter. Gamboge, however, is not an export from Ceylon, but is produced in Siam, a country as yet but little known to botanists. Whether gamboge was obtained from the same tree in Siam as that which yielded it in Ceylon could only be decided by the examination of good botanical specimens. Some years ago, Dr. Christison received from the Messrs. D'Almeida, of Singapore, specimens of *Garcinia* cultivated by them which had been brought from Siam as the true gamboge tree. Dr. Christison found the plant to be nearly allied to *G. Elliptica* of Wallich, but differed by having pedicellate instead of sessile male flowers. Recently the author has received specimens from the Messrs. D'Almeida, and has compared them with a variety of descriptions, figures, and specimens, the result of the comparison confirming Dr. Christison's observation that but for the pedicellate flowers the plant bore a strong resemblance to *Garcinia Elliptica*, and further came equally near *G. Morella* of Desrousseaux. Under these circumstances he sent specimens to Mr. Thwaites in Ceylon for his opinion, who replied that he believed the specimen to be a form of *G. Morella*, scarcely differing from the Ceylon type, except in having pedicellate in place of sessile flowers. The author and other botanists, therefore, now describe the gamboge-yielding plant under the following names and synonyms:—

Garcinia Morella, Desrouss; *Var. Pedicellata*, Syn; *G. Morella*, Desrousseaux; *G. Elliptica*, Wallich; *G. Gutta*, Wight; *Hebradendron Cambogioides*, Graham; *Var. β pedicellata floribus masculis pedicellatis*.

The number of trees now growing on the plantation of

Messrs. D'Almeida is twenty-eight. They are from thirty-five to fifty feet in height, and the largest has a circumference of three feet. They grow very luxuriantly on the side of a hillock without any attention. Gamboge has been at times extracted from them, but only as a matter of curiosity.

Professor BENTLEY said that Mr. Hanbury has now supplied the last link wanting in the chain of evidence to prove the true botanical origin of gamboge. He believed that there was no specific difference between the gamboge trees of Siam and Ceylon; they were simply varieties, depending probably upon soil and cultivation.

The next paper read was by Mr. ROBERTS, "*On Nitrite of Soda*." He remarked that the object of the authors of the Pharmacopœia was apparently to give a process for making sweet spirit of nitre which should be safe and easy. In the first step, however, a difficulty occurs—viz., in the preparation of pure nitrite of soda by the Pharmacopœia process. We are directed to make nitrite of soda by heating to dull redness a mixture of wood charcoal and pure nitrate of soda. Mr. Roberts made the experiment with the proportions named in, and according to the directions of, the Pharmacopœia, but with commercial nitrate of soda, and, as the result, obtained twelve ounces of a dirty reddish-brown salt. On testing this he found that 44 per cent. of this salt was soluble in rectified spirit. He repeated the experiment with pure nitrate of soda, and again obtained a coloured salt, in consequence, probably, of the crucible (a common clay one) being acted upon. This salt he found to be soluble in rectified spirit to the extent of 68 per cent. He next tried the experiment in a thin white crucible, but still obtained a coloured product, of which, however, from 60 to 70 per cent. was soluble in spirit. Of two samples of nitrite obtained from manufacturing chemists, he found one to dissolve in spirit to the extent of 60 per cent., and the other 66 per cent. The salt which dissolved in rectified spirit he found in cases to answer the Pharmacopœia tests—viz., to furnish nitrous fumes with tartaric acid, to yield a crystalline precipitate with nitrate of silver, and to give an emerald colour with a solution of sulphate of copper. He found, also, that it required one ounce of rectified spirit to dissolve ten grains of the salt. He then proceeded to ascertain whether nitrate of soda was soluble in spirit, and found that an ounce of rectified spirit dissolved four grains of that salt, which proved that solubility in spirit is no proof of the purity of the salt. The crystalline form of the nitrate and nitrite being, it is said, the same, it would seem impossible to secure a pure salt by crystallisation. The author exhibited a specimen of spirit of nitre made according to the British Pharmacopœia. It had the sp. gr. 0.840, and dissolved an equal volume of balsam of copaiba. It was freshly distilled, and at present neutral; but a sample he had previously made in the same way became acid in four or five days.

The CHAIRMAN expressed the pleasure he felt in listening to a paper by an Associate of the Society. It was to those who are now associates that the Society must look for its future reputation, and he was always glad when he saw one come forward with a communication.

Professor REDWOOD said that the Pharmacopœia process for the preparation of nitrite of soda was unequal to the production of the article. The salt produced was a variable mixture of nitrite, nitrate, carbonate with caustic soda if much heated. The alcohol test for nitrite was very fallacious. It was well known that nitrate of soda was soluble in rectified spirit; indeed, it was stated by Fischer that nitrate is more soluble in spirit than nitrite. The use of a salt made by the Pharmacopœia process in the preparation of spirit of nitre was objectionable on account of the uncertainty belonging to it. It would be much better to use the nitrate; that could be had pure, and the spirit of nitre was more likely to be uniform. There was, too, some doubt about the decomposition of the nitrites. It was

doubtful whether they gave off NO_4 or NO_2 when treated with an acid. The Pharmacopœia process for spirit of nitre was founded on the assumption that the best spirit of nitre would be a pure solution of nitrous ether, but the Professor thought we should be cautious how we were led away by the notion of a pure product. There were many substances used in medicine, in art, or as diet which owed their excellence to what some would call their impurities. They were not simple definable bodies, but still had their virtues and excellences. The old sweet spirit of nitre he considered one of these. It was a complex body in which nitrous ether was only one ingredient, and there were others on which the useful and agreeable qualities might depend. The old chloric ether was another beautiful and much esteemed preparation, which the solution of chloroform in spirit now made did not adequately replace.

The CHAIRMAN asked if the old Edinburgh process was not the best?

Professor REDWOOD said that if *sweet* spirit of nitre was wanted, he believed the old London process to be the best.

Dr. ATTFIELD thought it was best to endeavour to arrive at certainty with regard to the composition of medicines. Would it not be well to try the effect of a pure solution of nitrous ether before such a preparation was condemned? The P.B. process for nitrite of soda had certainly failed, but it did not follow that a pure nitrite could not be made. It would be well to try an experiment with carbon in a differ-

ent physical condition, and a lower temperature. Wood charcoal would decompose nitrate of soda below deflagration. Graphite also might be tried. Other reducing agents also might be tried. Some things seem to have a preference for particular oxidisers, and it might be the same with deoxidisers.

In a short reply Mr. ROBERTS said he thought it was his duty publicly to thank his principals (Messrs. Fisher and Haselden) for the opportunities and assistance they had given him in carrying out his experiments.

We must defer the other papers until next week.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 1, 1864.

R. ANGUS SMITH, Ph.D., F.R.S., &c., President, in the Chair.

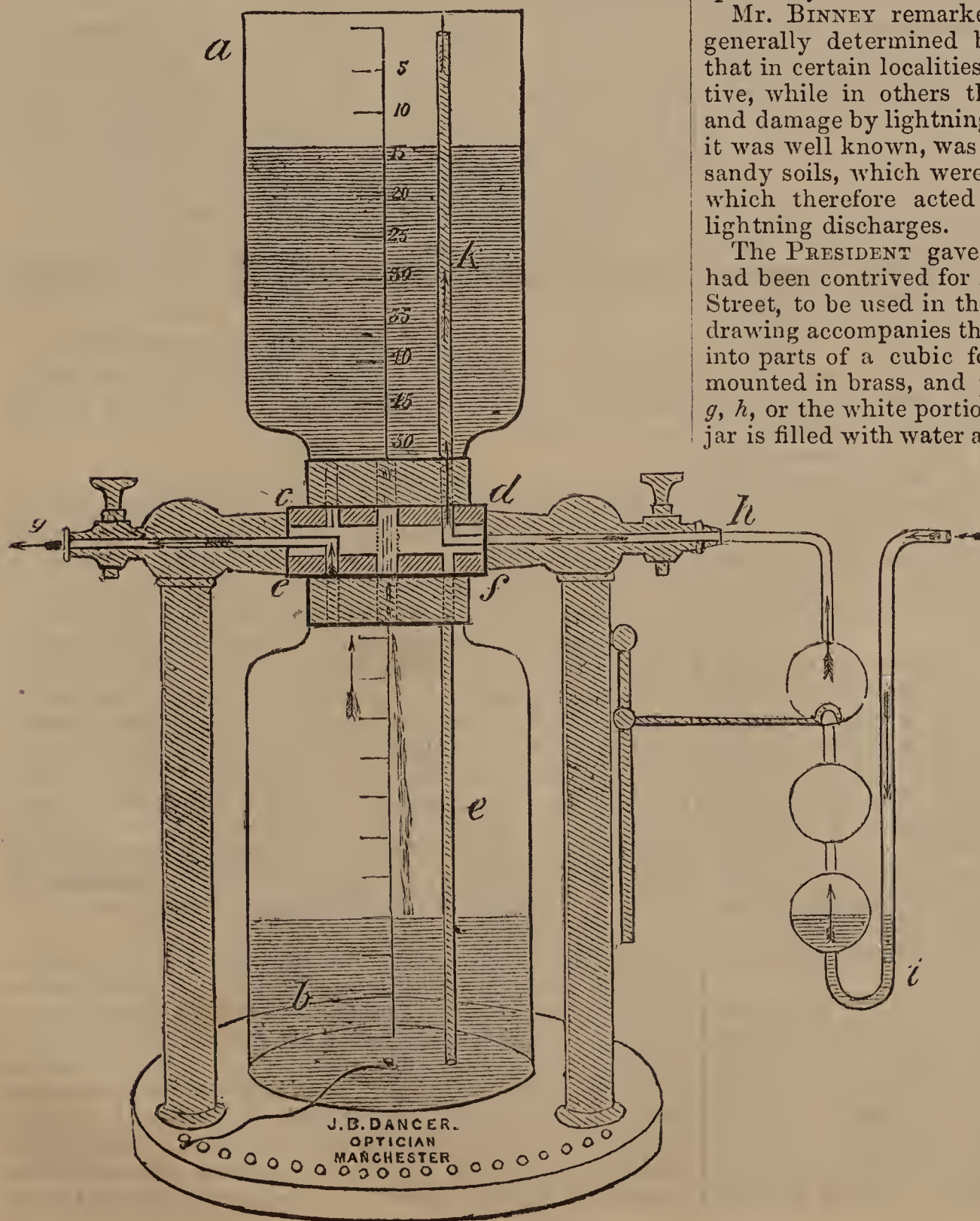
THE following gentlemen were elected Ordinary Members of the Society:—Mr. William Cort Wright, F.C.S.; Mr. George Heppel, M.A.; and Mr. William Mather.

Mr. SIDEBOTHAM said that he had noticed the common statement that beech trees were never damaged by lightning. He had been induced to collect facts on the subject, and had found that out of 28 instances the trees struck were—Oak, 9; poplar, 7; ash, 4; willow, 3; horse chesnut, 1; chesnut, 1; walnut, 1; thorn, 1; elm, 1, respectively.

Mr. BINNEY remarked that strokes of lightning were generally determined by the nature of the subsoil, and that in certain localities thunderstorms were very destructive, while in others they were comparatively harmless, and damage by lightning hardly ever occurred. The beech, it was well known, was generally found growing upon dry, sandy soils, which were bad conductors of electricity, and which therefore acted as protectors against destructive lightning discharges.

The PRESIDENT gave an account of an aspirator which had been contrived for him by Mr. J. B. Dancer, of Cross Street, to be used in the analysis of mixed gases, &c. A drawing accompanies this description. Two jars graduated into parts of a cubic foot, or according to pleasure, are mounted in brass, and placed mouth to mouth on an axis *g, h*, or the white portion enclosed by *c, d, e, f*. The upper jar is filled with water and the taps opened; then the water

flows from *a* to *b*, the air or gas entering by *h*, and passing previously through any solution that may be used, as at *i*. The gas enters *a* by the tube *k*, the air in *b* goes out by *c*. When *a* is emptied, it is simply turned round by the hand, and *b* the filled bottle stands uppermost. The shaded part of *c, d, e, f*, revolves with the jars, and the openings are so made as to form continuations of the openings in the axis *g, h*. The same conditions exist, no matter which jar is uppermost. This apparatus is very convenient in a laboratory, and has an advantage over other aspirators in measuring the gas. The measurements on the jars are made at a definite pressure of water, and this ought, of course, to be maintained when the numbers are read off. The apparatus is certainly very elegant, and is an ornamental as well as useful addition to a chemist's work table. It may be called Dancer's Aspirator, or the Swivel Aspirator.



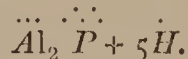
Dr. Boswell Reid describes one somewhat resembling this, but instead of having the swivel movement, it was necessary to lift the whole apparatus and to invert it. It was in reality two aspirators; one emptied itself into the other.

Dr. JOULE described the process he employed to harden steel wires for magnetic needles. The wire was held stretched between the ends of two iron rods bent into a semicircular shape. The free ends of the iron rods could be placed in connexion with a voltaic battery by means of mercury cups. Underneath the steel wire a trough of mercury was placed. When the ends of the iron rods dip into the cups the current passes through the wire, heating it to any required extent. When these ends are lifted the current is cut off, while at the same instant the heated wire is immersed in the trough of mercury.

ACADEMY OF SCIENCES.

December 5.

M. DAMOUR communicated a memoir "*On Callaïs*," a new hydrated phosphate of alumina, some personal ornaments made of which had been discovered in a Celtic tomb in Morbihan. The stone is a species of turquoise of an apple-green colour, which appears to be given by iron, and not by copper. The mineral is translucent, has a compact fracture like wax, is easily scratched with a file, forms a white powder, and has the density 2.50 or 2.52. It disengages water when heated to dull redness, decrepitates, loses its green colour and becomes brown, and is then very friable. It is infusible with the blow-pipe, but borax and microcosmic salt dissolve it easily without colouration. The author analysed the stone, and found the composition answer to the formula,



He considers that this stone answers the description given by Pliny of a stone, then called Callaïs, which modern mineralogists consider the Oriental turquoise, hence named Callaite. No sources of these minerals exist in France, and the author considers them both of Eastern origin.

M. Caron sent another memoir on the "*Cementation of Iron by Carbonic Oxide and by Contact with Carbon*," and this time quotes Dr. Percy's experiments in support of his assertion that carbonic oxide will not cement iron. He still insists that cyanogen is the active agent in the conversion of iron into steel, and quotes experiments to show that carbon destitute of alkalies has no effect on iron in contact with it. But when an alkali is supplied, and atmospheric air admitted, cementation is facilitated. Iron also heated with this inactive carbon in an atmosphere of ammonia is quickly cemented.

M. Blondeau presented a note "*On the Action of Nitric Acid on Cellulose*." In contact with concentrated nitric acid, cellulose, says the author, becomes more and more charged with that acid, until it arrives at a product having the composition $\text{C}_{12}\text{H}_{10}\text{O}_{12}(\text{NO}_5)$. The product placed in dilute acid undergoes a new modification and becomes soluble in nitric acid, disengaging binoxide of nitrogen. By this decomposition it forms *oxalhydric acid* $\text{C}_{12}\text{H}_{10}\text{O}_{16}$. This acid still left in nitric acid further decomposes. Bin-oxide of nitrogen is again evolved, and oxalic acid remains. These decompositions, he says, illustrate the tendency of all organic matter to assume a simpler and more stable form.

M. Boutin communicated a note "*On the Industrial Advantages to be Gained by Cultivating the Mahonia Ilici-folia*." This is the small evergreen shrub known in England as the Barberry. The author suggests that the juice of the berries of this plant may be used to furnish alcohol, of which it will yield 8 per cent., of an agreeable flavour, and suitable for making liqueurs. The wine made from it is acid and disagreeable. Further than this, he adds

that the pips when roasted made a drink very like coffee in taste and appearance, and quite as useful.

NOTICES OF BOOKS.

"*Our Inheritance in the Great Pyramid*." By Professor C. PIAZZI SMYTH, Astronomer Royal for Scotland. Alexander Strahan and Co., London. 1864. Pp. 400.

THIS book will be read with interest by the general public, but for the scientific reader it possesses unusual charms, on account of the depth of its information, the mathematical ingenuity displayed in its leading arguments, and the interesting historical references to problems in the way of standard weights and measures, and to the discussion of metrical systems which have lately been puzzling the House of Commons, the British Association, and other learned bodies. The frontispiece is a reduction from the excellent original photograph of Mr. Francis Bedford, representing a good view of the Great Pyramid of Jizeh, and there is a coloured map of the ancient pyramid-field in Egypt, besides several well-executed diagrams illustrating points of construction. The work is dedicated to the late John Taylor, Esq., of London, who appears to have devoted his life to the study of everything relating to the Great Pyramid, and upon whose previous literary inquiries in the form of the book entitled "*The Great Pyramid: why was it built?*" the argument of Professor Smyth is mainly founded.

The work before us sets out with the discovery of a remarkable geometrical proportion, viz., that the height of the pyramid (486 feet) is to twice the length of the base (1528 feet) as 1 : 3.144, or very nearly in the ratio of the diameter of a circle to its circumference. Professor Smyth has reason to doubt the accuracy of the measurements stated above, and he has corrected them to—

Vertical height of pyramid . 486.2567 feet
Breadth of base 763.8100 „

When, by the adoption of these numbers, the ratio comes out exactly

1 : 3.14159,

or precisely the relation of the diameter to the circumference of a circle. Proceeding a step further, the author shows that this curious relation may be stated in simpler numbers, thus—

116.5 : 366.0,

the latter figures suggesting the number of days in a year. If, then, the base, multiplied by two, be divided into 366 equal parts, we arrive at the "*primal metron*," or a length of about fifty inches, which Professor Smyth considers to have been the (larger) unit of measurement employed in the construction of the Great Pyramid, and which is exactly equal to $\frac{1}{10,000,000}$ th of the earth's axis of rotation!

There are other wonders wrapped up in the history of the Great Pyramid; for example, its square base is very truly oriented, or placed with its sides facing north, south, east, and west; the entrance is a narrow inclined passage opening from the north side, and above it is an air channel for the sake of ventilating the internal chambers. Both these straight channels have directions which suggest the probability of their having been employed for astronomical observation, since they point respectively to the upper and lower culminations of the Polar star of about 4300 years ago, or B.C. 2500.

The object of construction has been diligently sought for, and whilst evidence proves conclusively that all the other inferior pyramids in the neighbourhood were devoted to interment the corresponding features in this monster edifice are wanting. There is no doubt that this was the first of its kind, and that a variety of extraordinary precautions were taken to ensure the safety of its contents, and the very perfection of every part of the building. The rugged exterior is proved to be the result of the removal of the exquisitely finished marble casing stones, the last two of

which have been demolished since their discovery, in 1837, by Colonel Howard Vyse, and the apex of the pyramid has been gradually knocked away until now there is a platform on the top "large enough for eleven camels to lie down." However, regarding the interior, there is no likelihood of its having been a royal mausoleum, as were the other pyramids; the sarcophagus is wanting, but, curious to relate, there appears in its place an elaborately finished porphyry coffer, which has been a puzzle to scientific men before and since the days of Sir Isaac Newton. From the perpendicular sides, exactly regular form, and finished workmanship of this mysterious coffer, and absence likewise of any hieroglyphic inscriptions, it has been argued that it must tell its own tale, and that the determination of its precise dimensions must be a matter of vital importance. At page 103 of Professor Smyth's book the recorded measurements of some twenty-five observers are tabulated, and it is truly lamentable to notice the wide discrepancies between their several results. It will scarcely be credited, for instance, that the French academicians committed an error amounting to nearly three inches in taking the depth both inside and outside! And will it be believed that the great master of calculations, the profound Sir Isaac Newton, met in the porphyry coffer a stumbling-block indeed? for we find him actually "taking two measures of the *interior* and one of the *exterior*," in order to get at its cubical contents! The best measurement was that taken as far back as the year 1638 by John Greaves, Savilian Professor of Astronomy in Oxford, corrected subsequently by M. Jomard, which makes the interior of the coffer to be $77.806 \times 26.599 \times 34.298 = 70,982.4$ English cubic inches. What is this measure? Why, exactly the cubical contents of four British quarters of wheat, or $70,982.144$ English cubic inches—a lost measure rediscovered, says Mr. Smyth, for many have asked, "What do four quarters really make?"

The chapter on "British Metrology" is a carefully written account embodying the history of England's standard weights and measures—a narrative full of interest. Many of our readers may remember the pint being increased in value by Act of Parliament under George IV., and the old proverbial rhyme—

A pint's a pound
All the world round,

which was made to give place to the modern version—

A pint of pure water
Is a pound and a-quarter.

And old troy weight, according to which "thirty-two grains make one pennyweight," &c. And, many will remember the circumstance of the standard yard and pound being lost in the great fire which consumed the Houses of Parliament in October, 1834. How, that in the year following Francis Baily was entrusted with the reconstruction of the standards, and that he reported of the Exchequer standard yard, "that it was impossible to speak of it too much in derision and contempt; for it had been broken asunder, and the two pieces were dovetailed together; but so badly, that the joint was nearly as loose as a pair of tongs." The present standard yard is considered by Professor Smyth to be short of its true length by about one-thousandth part, and he would prefer to rely upon the Exchequer ell, which, according to Graham in 1743, was "found to be .0494 inch longer than 45 such inches as were contained in the Exchequer yard of 36 inches, but was in excess by .0075 inch of the Royal Society's scale." Therefore, $.0494 - .0075 = .0419$ actual excess; and $45 \times .0419$ modern inches are consequently equal to 45 old standard inches, or differ in the ratio of $1.00093 : 1$. If, now, the "primal metron" already alluded to as having been deduced from the measurements of the Great Pyramid be divided into fifty equal parts, we obtain the smaller unit, or "pyramid inch," which is equivalent to 1.00069 of our present linear inches, and must be, as already shown, $\frac{1}{50,000,000}$ th part of the earth's

polar axis. In his table of linear measures, page 218, Professor Smyth retains the inch and foot, and proposes a new one of 25 inches to be called the "arm." This length (a half metron) the author imagines to have been employed by the Egyptian artificers as a common rule of convenient length. And it is one which has lately become a favourite scale with the British Government; thus, the new Ordnance Survey maps are *said to be*, but not truly, 25 inches to the mile, or one square inch to an acre. Professor Smith says:—"It is truly of the proportion of $\frac{1}{2500}$ th of nature; and that gives, on the British measure, 25.344 inches to one mile, and 1.018 inches to an acre as the scale of the maps."*

In reviewing the French metrical system (the introduction of which has of late been strongly advocated), Professor Smyth conceived it to be founded upon a false and uncertain basis. The usual definition of a metre is that it shall be equal in length to $\frac{1}{10,000,000}$ th of a quadrant of the earth's *surface*! Now it has lately been shown by M. de Schubert "that the earth's equator is not a true circle, but a rather irregular curvilinear triangle, so that it has many different equatorial axes, and therefore also *different* lengths of quadrants in different longitudes."

Admitting the advantages of a decimal system, but rejecting the French code for the reason just now assigned, our author insists upon the importance of taking a small measurement as the unit, and quotes the evidence of Sir William Armstrong and Mr. Whitworth as supporting his opinion in favour of a standard inch. Sir William Armstrong said at the Newcastle meeting of the British Association that "in the Elswick works, as well as in some other large establishments of the same description, *the inch is adopted as the unit*, and all fractional parts are expressed in decimals." And Mr. Whitworth in his examination before the Lords' Committee in 1855, exhibited an inch measure, with an apparatus for testing its length to the millionth of an inch; and insisted on "the greater importance to all who are engaged in the mechanical arts to have a standard foot and a standard inch, than to have a standard yard."

After giving a full description, in several chapters, of the points of construction and remarkable coincidences involved in the Great Pyramid, Professor Smyth (at p. 302) commences a most interesting account of the difficulties experienced by Francis Baily, Troughton, Kater, the Rev. R. Sheepshanks, and others, in their attempts to construct the modern standards; these failures have arisen from the alterable nature of the materials employed, and the objection is fairly met by the author in his proposal to select porphyry, or other hard, fused, and durable rock for the manufacture of these scales. The first standard of F. Baily was of drawn brass tube, and was condemned in the short space of fifteen years as having altered its size. From wrought metal, which is always seeking to recover itself from the strains of the hammering or rolling, he went to cast metal; and from a soft, flexible metal like brass, he went to hard gun-metal, with an improved result, but still far from perfection. On his death the subject was taken up by the Rev. R. Sheepshanks, who preferred pure metals rather than alloys, and had a great idea of cast copper, notwithstanding its softness, and the trouble of preparing it in a sound state. The opinion of Professor Faraday was asked, and he reported, in 1847, as follows:—"I do not see any reason why a pure metal should be particularly free from internal change of its particles, and on the whole should rather incline to the hard alloy than to soft copper, and yet I hardly know why. I suppose the labour would be too great to lay down the standard on different metals and substances; and yet the comparison

* It would appear that Professor Smyth is, like the great Sir Isaac Newton, not infallible. The numbers just given are quoted literally from page 221 of the work before us, but the learned professor has surely magnified the error of the Ordnance Survey maps tenfold! A nought is required to be inserted next after the decimal point in the second instance, and their true scale becomes 1.0018 inches to an acre.

of them might be very important hereafter, for twenty years seem to *do* or *tell* a great deal in relation to standard measures."

And later, in 1857, we find Professor Airy communicating to the Royal Society the particulars of 47 bars of gun-metal, 9 of brass, 2 of copper, 9 of forged iron, 4 of cast iron, and 6 of cast steel, then being converted into standards of British length-measure; and these constitute the sum of what the nation has to trust to through future time, the older reference to natural standards having been officially thrown overboard. *Vide* "Report of Treasury Commission on Standards," March 28, 1854:—"We adhere to the recommendation (offered in 1841) that no reference be made to natural elements for the values represented by the standards."

Professor Smyth tells well the story of how the standard pound weight of platinum, prepared only ten years ago, was recently discovered to have become "coated with an extraneous substance produced by the decomposition of the lining of the case in which it was preserved." But for these and many other interesting particulars we must refer to the original work.

On the subject of heat and its registration, Professor Smyth has some good ideas. He recommends a division of the thermometer scale into 250 degrees, ranging from the freezing to the boiling-point of water, and starting (like the centigrade scale) with its zero at the freezing-point. Such small degrees would surely be very convenient, as avoiding fractions for all practical purposes, and would carry out still further the idea which has no doubt served to confirm the use of the unmeaning Fahrenheit scale in this country. The upper limit of Mr. Smyth's scale would be 1000° (=752° Fahr.), or the point at which "iron becomes bright red in the dark," according to the "Natural Philosophy" of the Society for the Diffusion of Useful Knowledge.

The same Temperature According to Five Different Thermometric Scales.

Fahrenheit.	Modified Fahrenheit.	Centigrade.	Reaumur.	C. P. Smyth.
deg.	deg.	deg.	deg.	deg.
32	0	0	0	0
104	72	40	32	100
122	90	50	40	125
212	180	100	80	250

Space will not permit of a more lengthened examination of the contents of this entertaining book. If the statements contained therein are not actual facts, then, indeed, must they be considered as a most remarkable collection of coincidences. We understand that Professor Smyth is about to proceed to Egypt to test for himself the truth of the conclusions drawn by himself and others, and he will be prepared, through the agency of magnesium and photography, to lay open to public observation the mysterious interior of the Great Pyramid. And we may hope eventually to hear from the hero of Teneriffe the relation of his successful travels, and see for ourselves the hidden recesses of one of the wonders of the world by taking no more trouble than is usually attendant upon a journey to Albemarle-street.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2484. James George Bechton, Whitby, Yorkshire, "Improvements in heating retort and other ovens for the distillation of shale, coal, and other substances."—Petition recorded September 20, 1864.

2884. Michael Henry, Fleet Street, London, "Improvements in the mode of, and apparatus for, carbonising wood and performing other operations in which substances are

treated by flame or heat."—A communication from Pierre Hugon, Boulevard Saint Martin, Paris, France.

2889. Septimus Piesse, New Bond Street, Middlesex, "Improvements in apparatus for creating and projecting cold vapours."—Petitions recorded November 18, 1864.

2906. Alfred Vincent Newton, Chancery Lane, Middlesex, "An improvement in the manufacture of sugar, and in the machinery to be used therein."—A communication from Charles Rostaud, Rue St. Sebastien, Paris, France.

Invention Protected by Deposit of Complete Specification.

3042. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of illuminating gas." A communication from William Elmer, New York, U.S.A.—Petition recorded December 6, 1864.

Notices to Proceed.

1875. Jean Pierre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in preventing oxidation of iron or steel."

1876. Jean Pierre Chambeyron, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of steel."—Petitions recorded July 27, 1864.

1880. Elizabeth Brinson, Frome, Somersetshire, "Improvements in envelopes or covers for bottles and jars."—Petition recorded July 28, 1864.

1931. Charles Garton, Bristol, Somersetshire, and Thomas Hill, Southampton, "Improvements in mashing apparatus."—Petition recorded August 3, 1864.

1941. Francis Cruickshank, Edinburgh, N.B., "Improvements in coatings for the prevention of the fouling of the bottoms of iron and other ships."—Petition recorded August 4, 1864.

1963. Neil McHaffie, Broad Street, Mile End, Glasgow. "Improvements in treating iron plates for ship-building, boiler-making, and similar uses, and also wrought iron in other forms to render it capable of resisting oxidation or destruction by sea and other water, and atmospheric and other corroding influences."—Petition recorded August 6, 1864.

2806. George Smith, Bradford, Lancashire, "Certain improvements in machinery or apparatus for drying or dessicating materials or substances containing moisture."—Petition recorded November 11, 1864.

2927. Francois Pfauhauser, Winsley Street, Middlesex, "An improved process of tanning."—Petition recorded November 23, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, December 13.

A FEW weeks ago I mentioned the subject of vaccination, and called attention to the practice followed at Naples of vaccinating directly from the cow. The subject has been seriously taken up here, and it is estimated that a good commercial speculation may be made of it. A cow, it is said, will produce 100 pustules, which, at 5 francs each, will bring 500 francs, the cow suffering no deterioration in value. The practice is greatly recommended by the safety it ensures that no other contagion will be communicated along with the cowpox. Smallpox is rather prevalent in and around Paris, and people are becoming anxious on the subject. It is recommended here that the cow should be vaccinated by twelve or fifteen small punctures around the vulva, a part the animal cannot get at. The pustules ripen about the 8th or 12th day. The lymph is too thick to be got into tubes, but must be taken on glass plates, which can be moistened when the matter is wanted. A good idea has been started by one doctor, namely, that it will do just as well to drink the milk of an infected cow as to get vaccinated. The doctor has made the experiment. He vaccinated a cow on the udder

and got two good pustules. He then gave the milk to two infants, and afterwards tried to vaccinate them, *but without success*, while a third infant who had had none of the milk was at once inoculated by the same virus. He recommends that young ladies who are afraid of a prick with a lancet should drink a glass of milk every three or four years to save them from the small-pox!!

M. Schmidt recently communicated to the Belgian Academy some observations he made at Athens on shooting stars. He has established some numerical relations between the number of meteors, the detonations, the falls, the tails, and the colours, which may have some interest for your readers. He says that the detonations and falls are fewest when the meteors are most numerous—*i.e.*, in August and November. The greatest number of stars fall in May. Most tails are observed when the meteors are numerous. Red and green coloured meteors are most often seen in summer. The author has noted the colour of 5671 meteors; 4300 of which were white, 905 yellow, 320 red, and 146 green.

Some more information about the Giessen Congress has now reached me through the pages of the *Moniteur Scientifique*, but still intrinsically very little. Most of the chemical papers read—88 per cent. of the total number, in fact—were on organic chemistry, in which department the reporter is not strong; so he shirks the matter, and, indeed, to some extent, pooh-poohs modern organic chemistry. I feel disposed to quote a portion of his remarks, for I believe that there are many chemists who would agree with the substance of them. At one of the sittings, Dr. Hofmann gave a *resumé* of his investigations on the chemical nature of the aniline dyes, and mentioned the interesting fact that it was five-and-twenty years ago, when a simple student at Giessen, that he began his researches on aniline, with little idea, I dare say, that they would ever receive the extensions he detailed that day.

Some other small matters deserve notice. Boettger described a method of writing on zinc, which may be useful to some of your readers, though I am not certain that the method is new in England. He takes one part of chloride of platinum and one part gum arabic, and dissolves them in ten parts of water. With the solution he writes on the zinc, and so obtains black characters, which are unaffected by dilute acids. When the zinc plate is placed in dilute nitric acid, the parts not written upon are eaten away, and the writing stands out in relief. The author suggested that this was a good way of making garden labels for plants. The same gentleman exhibited some mirrors silvered by Bothe's process. The inventor makes use of a mixed solution of ammoniacal nitrate of silver with oxytartrate of silver—(proportions not given)—and the results are said to be very beautiful. Dr. De Vry exhibited a specimen of what he called "the sugar of the future." This is procured from the juice of certain palms growing in Ceylon and Java, and is, it seems, producible with great ease in large quantities. Dr. Frank described the salt deposits at Stassfurt, where, you will remember, a bed of chloride of potassium, or, rather, a layer containing a large proportion of chloride of potassium, is found to overlie a deposit of chloride of sodium. The potassium salt is separated by successive crystallisations, and is obtained tolerably pure, as the English makers of saltpetre know.

Spontaneous generation was, of course, largely discussed at the Congress, and the antiquity of man and the Neanderthal skull were subjects frequently alluded to. The possessor of that skull when alive could have little idea of the noise he would one day make in the world. Lastly, I may shortly mention the paper by Helmholtz on the sounds of muscles, which will no doubt excite great attention, since it serves to explain the first sound of the heart. The author showed that the contractions of muscles are attended with the production of sound, by which he is enabled to determine the number of vibrations

in the muscle. You will, no doubt, have the entire paper in England soon, and will see the importance of the matter to the physiologist and physician.

MISCELLANEOUS.

Renard v. Levinstein.—This important trial commenced on Tuesday last, before Vice-Chancellor Page Wood. The subject in dispute, our readers will remember, is a patent for the production of a blue dye granted to M. C. A. Girard. The specification of this patent will be found below. It will be in the recollection of our readers that an injunction was granted by the Vice-Chancellor to restrain the defendant from making a blue aniline dye, which injunction was dissolved by the Lords' Justices, on the grounds that no infringement of Girard's patent had been proved, and that the validity of the patent was open to dispute. The present is a trial without a jury to establish the validity of the patent, and prove the infringement by the defendants. An unusual amount of interest has been given to this trial by the circumstance that a number of eminent French chemists have been examined for the plaintiff. Besides the patentees, MM. Girard and Delaire, of the French mint, MM. Persoz, Cahours, and E. Kopp, have given evidence, the last in excellent English. Besides these, Drs. Hofmann and Frankland, Mr. Abel, and several other London chemists, were examined for the plaintiff, whose case had not concluded at the early date on which we are compelled to go to press. In our next we shall give a succinct *resumé* of the evidence on both sides. In the meantime we publish the specification of the patent which is the subject of dispute.

"Letters Patent to Charles Adam Girard, of 17, Boulevard du Temple, Paris, in the Empire of France, for the invention of 'Improvements in preparing colouring matters for dyeing and printing.'—Partly a communication from abroad by Mr. Georges de Laire, of the Mint, in Paris.

"Sealed the 9th July, 1861, and dated the 12th January, 1861.

"Provisional specification left by the said Charles Adam Girard at the office of the Commissioners of Patents, with his petition, on the 12th January, 1861.

"I, Charles Adam Girard, of 17, Boulevard du Temple, Paris, in the Empire of France, do hereby declare the nature of the invention for 'Improvements in preparing colouring matters for dyeing and printing' to be as follows:—

"For these purposes red aniline dye is purified and mixed with a quantity of aniline. The proportions which I prefer to employ are about equal quantities of aniline and of red aniline dye. The mixture is maintained for several hours at a temperature between 155° and 180° (Centigrade), and as nearly as possible to 165°. The substance, which is now violet, is boiled with a mixture of water and hydrochloric acid. The excess of aniline and of red dye which has not been transformed is dissolved, and a violet residue remains. This residue is completely soluble in alcohols, acetic acid, wood spirit, and boiling water slightly acidulated with acetic acid. All these solutions may be employed directly for dyeing violet. In order to obtain the blue dye the violet mass is boiled several times with hydrochloric acid diluted with a small quantity of water and then washed with boiling water. The substance thus obtained is a blue having a beautiful coppery lustre. To employ this colour in dyeing it is sufficient to dissolve it in vinegar, or alcohol, or wood spirit, and to dilute these solutions with a convenient quantity of water. I would state that liquids obtained by treating the violet mass with hydrochloric acid and water contain, as I have said, hydrochlorate of aniline and red dye. They are precipitated by an alkali, and aniline, which may be purified by distillation, is thus recovered.

"Specification in pursuance of the conditions of the Letters Patent, filed by the said Charles Adam Girard in the Great Seal Patent Office on the 12th July, 1861.

"This invention has for its object improvements in preparing colouring matters for dyeing and printing. For these purposes I take red aniline dye, a substance now well known, and which is prepared from aniline, or more commonly from a mixture of aniline with its homologues, and which may be prepared from the homologues of aniline, and this dye having been purified in the usual manner, is mixed with a quantity of aniline. The proportions which I prefer to employ are about equal quantities by weight of aniline or its homologue and of red aniline dye. The mixture is maintained for several hours (say about five or six) at a temperature between 155° and 180° (centigrade), and as nearly as possible to 165°. The substance, which is now violet, is boiled with a mixture of water and hydrochloric acid, say ten or twelve parts of acid to one of the substance, the acid being mixed with a large quantity of water, and the boiling is continued until the washing is complete. The excess of aniline and of red dye which has not been transformed is dissolved, and a violet residue remains. This residue is completely soluble in alcohol, acetic acid, wood spirit, and boiling water slightly acidulated with acetic acid. All these solutions may be employed directly for dyeing violet. In order to obtain the blue dye the violet mass is boiled several times with hydrochloric acid diluted with a small quantity of water, say ten parts of hydrochloric acid of commercial strength to one hundred parts of water, and then washed with boiling water, the boilings being continued until the operation is complete, as will be readily ascertained from the appearance of the dye. The substance thus obtained is a blue, having a beautiful coppery lustre. To employ this colour in dyeing it is sufficient to dissolve it in concentrated acetic acid, alcohol, or wood spirit, and to dilute these solutions with a convenient quantity of water. I would state that liquids obtained by treating the violet mass with hydrochloric acid and water contain hydrochlorate of aniline and red dye: they are precipitated by an alkali, and aniline, which may be purified by distillation, is thus recovered. I would also remark that, in place of first preparing a red dye and purifying the same, a similar result may be obtained by treating aniline with reagents, such as are ordinarily employed to convert it into red dye, but using an excess of aniline, so that the first action is to convert a part of the aniline into red dye, and then, the heat being maintained as hereinbefore mentioned, the excess of aniline converts the red dye into the violet substance; I prefer, however, to conduct the process in the manner first described.

"Having thus described the nature of my invention, and the manner of performing the same, I would have it understood that what I claim is the treating red aniline dye with aniline or its homologue so as to transform it into other dyes, as hereinbefore described."

Dublin International Exhibition, 1865.—On Wednesday evening last Sir Robert Kane delivered a lecture at the Society of Arts "*On the Recent Progress and Present State of Industry in Ireland, and the Dublin International Exhibition of 1865.*" The meeting was exceedingly well attended; and the prospects of the coming Dublin Exhibition look remarkably promising. We may inform our readers that the arrangements of classes will be the same as at the London Exhibition of 1862. Class A, section 2, will comprise chemical and pharmaceutical processes and products generally; and a section of Class B will include philosophical instruments and processes depending on their use, photographic apparatus, surgical instruments, &c. All these manufactures, we should hope, would be well represented from England. One of the Committee, who has visited all the principal seats of industry on the Continent, has returned with flattering

promises of support from the manufacturers, and great encouragement from the various governments. The building, we may state, is already approaching completion; and the Exhibition will open on Tuesday, May 9. A London Committee of Advice, of which Mr. P. L. Simmonds is secretary, sits at the house of the Society of Arts, from whom any information that intending exhibitors wish for can be obtained.

Serious Case of Poisoning.—We are happy to be able to state that the case of poisoning at York, related under the above heading in our number for December 3, has been shown to be simply the result of an excessive dose of morphia, and not the consequence of a mistake on the part of Mr. Hardman's porter. Dr. Proctor, who has been kind enough to forward us his evidence at the inquest, made a post-mortem examination of the body and an analysis of the contents of the stomach. In the latter he discovered no other poison besides morphia, which it was known the deceased had long been in the habit of taking. The heart of the deceased showed signs of fatty degeneration, and the verdict was death from that cause, accelerated by an overdose of morphia taken voluntarily.

Actonian Prize Essay of 200 Guineas.—Attention is directed to the following advertisement, which appeared in the *Times* of May 28, 1863. It will be seen that the latest period for the acceptance of the essays is fixed at a fortnight from the present date.

(Copy.)

"ROYAL INSTITUTION OF GREAT BRITAIN, ALBEMARLE STREET.—The next Actonian Prize or Prizes will be awarded in the year 1865 to an Essay or Essays illustrative of the Wisdom and Beneficence of the Almighty as manifested in any of the Phenomena of Radiation. The prize fund will be 200 guineas, and may be awarded as a single prize, or in sums not less than 100 guineas each, or withheld altogether, as the Managers in their judgment should think proper.

"Competitors for the prize are requested to send their Essays to the Royal Institution on or before ten o'clock p.m., December 31, 1864, addressed to the Secretary; and the adjudication will be made by the Managers in April, 1865. "H. BENICE JONES, Hon. Sec., R.I.

"May, 1863."

ANSWERS TO CORRESPONDENTS.

. In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

. All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements and Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Leather Dresser.—There is no work which we can recommend you.

Dr. Adriani.—It is obviously only an abstract, but it is all that has reached us.

J. Sutcliffe.—It can only be procured in a volume with the rest of the reports.

J. B. Pearse, United States Army Laboratory.—There is great difficulty in procuring the work, but we will do our best for our correspondent.

J. J.—Zinc-ethyl, but it must be sealed in a tube. Lead pyrophorus, a powder, will do as well, and is much more easily procured.

Kamptulicon.—The material to which you refer is a combination of cork raspings and india-rubber. You are mistaken in supposing the latter to be in the vulcanised condition, for on digesting with coal-naphtha the rubber is easily dissolved, and its proportion may be ascertained by recovering it from the filtered solution on the evaporation of the solvent, or indirectly by weighing the cork.

A Brazier.—Common brass always contains lead, and sometimes a little tin, in addition to copper and zinc. The composition of the best sheet-brass varies from 66 to 70 per cent. of copper, the rest being zinc. There can be no doubt that the addition of iron does confer increased strength, but there is then a liability of the alloy rusting by exposure. For further particulars, see "*Percy's Metallurgy*," Vol. I.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Notes on the Platinum Metals and their Separation
from Each Other, by M. C. LEA, Philadelphia.*

PART I.*

(Continued from page 281.)

The reaction of the alkalis on the chlorides of iridium are altogether peculiar. Upon the bichloride they exert a reducing effect, converting it into sesquichloride. An excess of alkali does not precipitate the sesquioxide, but seems to hold it in solution. On the application of heat the sesquioxide gradually oxidises itself at the expense of the atmosphere, and is then precipitated as deutoxide of iridium. If to the cold solution containing excess of alkali an acid be added in small quantity, an impure sesquioxide is precipitated, in consequence of the neutralisation of the alkali which held it in solution. But the sesquioxide thus precipitated always contains a considerable quantity of the alkali used. It is very unstable, and by the action of the air is rapidly converted into blue oxide. This is nearly all that we know of the sesquioxide of iridium.

Under these circumstances it appeared to me desirable to investigate the action of some of the alkaline earths upon iridium solutions, which, it seemed possible, might throw a clearer light upon the relations of the sesquioxide.

When a solution of caustic baryta is poured over iridium sal ammoniac, the iridium salt rapidly dissolves with a slight effervescence; the solution presently becomes comparatively decolorised, and a dark olive-green precipitate falls. This reaction, it will be observed, is completely different from that caused by potash.

The filtrate from this precipitate, which precipitate is but small in quantity, still contains a large quantity of iridium. If it be exposed to heat as soon as it is moderately warm, its dark olive colour changes almost suddenly to an Isabella colour, it becomes cloudy, and an abundant precipitate falls, which, in different experiments, varies from pale grayish-yellow to yellowish brown.

It was intended to submit both of these precipitates to a rigorous analysis; but the first was obtained in too small quantity—a few centigrammes only. The second substance was much more abundant in quantity. A portion of it was prepared with great care, and with thorough exclusion of air, to prevent any admixture of carbonate of baryta. But upon careful examination it was not sufficiently homogeneous in its composition to enable one to draw positive conclusions from an analysis, and the intention was, therefore, abandoned. The following were the properties observed:—

The olive green precipitate seemed to be permanent in the air, and contained no baryta, or at most only traces. It dissolved in acids, leaving, however, a trace of black powder behind, and gave an olive-coloured solution, indicating that the iridium was in the condition of sesquioxide.

The Isabella-coloured precipitate contained a considerable quantity of baryta. It dissolved in acids, and gave, when freshly prepared, also olive-coloured solutions. When dried at 212° , it was completely converted into an indigo-coloured mass, which dissolved in acids to an intense blue solution. When allowed to dry at ordinary temperatures, even by exposure to the air, it was only oxidised in small part.

To observe the action of potash on this compound, a portion of the Isabella-coloured precipitate was placed in a watch-glass, and a little caustic potash solution was poured over it. In a few minutes a blue tint was observable along the borders of the solution, and by exposure for a few hours the whole precipitate became intensely blue. We thus see that while potash is capable of reducing the bi-salts of iridium to sesqui-salts, its presence causes the sesquioxide to take up oxygen from the atmosphere, with production of bioxide; and that, for this action to take place, it is not necessary that the sesquioxide should be in that anomalous state of solution in alkali, in which it seems to exist in solutions of bichloride decolorised with excess of alkali; but that the barytic compound here described, which is comparatively more permanent by itself, commences immediately to oxidise rapidly when placed in contact with potash.

Other reactions of platinum metals with baryta are as follows:—

Sesquichloride of Ruthenium and Ammonium is immediately and completely precipitated by baryta in the cold.

Bichloride of Ruthenium and Ammonium gives no precipitate to the cold. Heated, it turns yellowish-brown, and becomes turbid. This turbidity is completely removed by the addition of a large excess of the precipitant. If the baryta have been added to large excess at first, no turbidity is occasioned by the application of heat.

Protochloride of Palladium is precipitated immediately in the cold by baryta. The brownish yellow precipitate does not re-dissolve in excess of the precipitant. In this the reaction of baryta differs from that of potash.

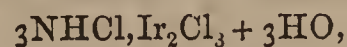
Bichloride of Platinum is scarcely affected by baryta water in the cold. Heat immediately produces a dirty white precipitate, the supernatant liquid remaining of a yellow colour.

Sesquichloride of Rhodium gives an immediate light coloured precipitate with baryta, which completely redissolves in a very large excess of the precipitant, even in the cold.

It will be seen from the foregoing that the reaction of baryta with the platinum metals differ widely from those produced by potash, and are highly characteristic.

Two of these solutions which much resemble each other, those of bichloride of ruthenium and sesquichloride of rhodium, are very well distinguished from each other by baryta, the former remaining for some time clear, the latter being instantly precipitated. The production of a well-marked precipitate is generally a better test than a mere change of colour, as produced by potash, which has hitherto been considered the best reagent to distinguish between these two substances.

The relations to colour of the double sesquichloride of iridium and ammonium—



are curious, and have not been exactly described. It is generally said that its solution is olive green by reflected, and reddish by transmitted light. The following is a more correct description:—

A dilute solution of the salt is always olive green, whether seen by reflected or transmitted light. If it appears red by transmitted, when very dilute, this can only arise from the presence of bichloride of ruthenium, or sesquichloride of rhodium.

As its concentration increases, it gradually acquires a red colour, visible by both reflected and transmitted light, but more conspicuous by the latter. A very strong

* *Am. Journ. Science and Arts*, No. 112, Vol. xxxviii.

solution is almost opaque to transmitted rays; by dilution passes to a deep wine red. This wine red solution is by reflected light olive green, but with a distinct tinge of red. Nor has it before been remarked, I believe, that the crystallised salt exhibits the same dichlorism. The crystals are deep green, by reflected light almost black. When placed so that light can strike through a dihedral angle, its colour is ruby red.

Strong and weak solutions of this salt differ so much in colour (in tint, not merely in intensity) that at first one has a difficulty in believing that they contain one and the same substance.

New Ruthenium Reaction.—A series of experiments on the reactions of the platinum metals are as yet unfinished, but I take the present opportunity to mention a new and very beautiful reaction of the sesquichloride of ruthenium.

When a solution of hyposulphite of soda is mixed with ammonia, and a few drops of solution of Ru_2Cl_3 are added, and the whole boiled, a magnificent red purple liquid is produced, which, unless the solutions are very dilute, is black by transmitted light. The colouration is permanent, and the liquid may be exposed to the air without alteration.

This reaction is obtained with great ease and certainty, and will, I believe, be found far superior to any known test for ruthenium.

In order to determine the limits of the sensibility of this reagent, experiments were made with ruthenium solutions of different strengths. A portion of perfectly pure Ru_2Cl_3 was weighed out in a delicate balance, and the following indications were obtained:—

With $\frac{1}{5000}$ th Ru_2Cl_3 bright rose purple.

With $\frac{1}{20000}$ th and $\frac{1}{30000}$ th, fine rose colour.

With $\frac{1}{50000}$ th, paler, but still perfectly distinct.

With $\frac{1}{100000}$ th, the colour, though very pale, was still unmistakeably present.

Where the solutions are so very dilute as these last, the boiling must be continued for some minutes.†

Although the sulphocyanide test is very delicate, it is not equal to this, as was determined by a comparative trial. It is also liable to the objection that when employed to examine mixtures the presence of iron might be confusing. For although the reaction of ferric salts with sulphocyanide gives a different shade of red, yet it is to be observed that the two colours approach each other considerably when much diluted. Moreover, in using the sulphocyanide test, I find it best to acidulate the liquid strongly with chlorhydric acid, and to obtain a chlorhydric acid absolutely free from iron, so that it does not give the slightest colouration with the sulphocyanide. It is generally necessary (in America, at least) to prepare it for oneself.

The delicacy of this test does not, however, constitute its greatest value and superiority. The reactions of ruthenium are remarkably affected by the presence of iridium; and in proportion as this last-named metal is present in larger quantity, the indications afforded by all the tests hitherto known grow less and less decided, and some lose all efficacy. The test here proposed is the first known reagent that is capable of detecting ruthenium in the presence of any excess of iridium. No precautions are necessary, and the reaction is always obtained

with the greatest facility. The iridium solution is to be rendered alkaline with ammonia, a crystal of hyposulphite of soda is dropped into it, and the whole is boiled for two or three minutes. If no indication of a red purple tint appears (or, in case of small quantities of ruthenium, a rose colour), the iridium solution may be pronounced free from ruthenium.‡

It would appear that there must exist very beautiful purple and green compounds of ruthenium, with which we are at present unacquainted. The purple compound appears to be produced in several reactions, and notably in that just described, and in the sulphocyanide. There can be little doubt that sulphur enters into its composition. The green compound is produced when a solution of Ru_2Cl_3 is boiled with ferrocyanide of potassium. Claus remarks in reference to this colouration that he is unable to explain its cause. It is, however, unquestionably due to a compound of ruthenium, and not to the production of any prussian blue or green compound, for I find that the green reaction can be obtained in presence of a large excess of free ammonia, together with which it is hardly necessary to remark, the last-mentioned compounds could not exist. I propose to return to the subject of the ruthenium reactions at a future occasion.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 15.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,
in the Chair.

At this meeting there was an unusually large attendance of members, and the Society was favoured by the presence of Professor Emile Kopp and other visitors.

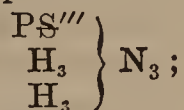
Dr. Hermann Sprengel and Mr. A. P. Tarner were formally admitted Fellows of the Society, and Mr. Alexander Stewart, Apothecaries' Hall, London, was duly elected by ballot. The names of Mr. Alfred Noble, Bristol, and Mr. J. Carter Bell, Manchester, were proposed for the second time, and will be balloted for at the next meeting; and the names of the following candidates were read for the first time:—viz., Mr. Charles Eastcourt, Manchester; Mr. Thomas Porter Blunt, B.A., Oxon., Shrewsbury; Mr. Robert M'Donald Bosanquet, Oxford; Mr. Nathaniel Bradley, Prescott, Lancashire; Mr. Richard Percival, University of Glasgow; Mr. Thomas Heathcote Windham; Mr. Arthur Smith, Loughborough Road, Brixton; Mr. Arthur Vacher, 29, Parliament Street, London; and Mr. Francis Walker, Sidney College, Cambridge.

Dr. J. H. GLADSTONE then read a paper "*On the Action of Ammonia on Sulpho-Chloride of Phosphorus*," which describes the results of experiments made by himself and Mr. J. D. Holmes in continuation of the research communicated on a former occasion, and printed at page 225 of the second volume of the Society's journal. The authors state the sulpho-chloride of phosphorus is capable of absorbing four equivalents of ammonia gas, with production of a white coherent mass, which consists of chloride of ammonium in admixture with a substance of doubtful composition, probably $\text{P}(\text{NH}_2)_2\text{ClS}$, but which is decomposed by contact with water into hydrochloric acid and a new body, named thiophosphodiamic acid, and having the formula $\text{P}(\text{NH}_2)_2\text{HSO}$. The last-named substance, or rather the aqueous solution of the crude product, after being neutralised, has the property of forming

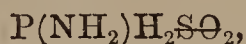
† When the presence of ruthenium in very small quantity, or in very dilute solution, is suspected, it is often advisable to boil the solution with a little chlorhydric acid, previous to the application of the hyposulphite, sulphocyanide, or other test. The explanation of this will be given in the second part of this paper. With the hyposulphite test, the acidulated solution must be rendered alkaline by addition of ammonia before heating with hyposulphite.

‡ The second part of this paper will contain an examination of the reaction of hyposulphite of soda, and other reagents, upon the various metals of the platinum group.

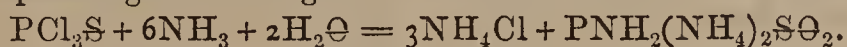
flocculent precipitates with a variety of metallic solutions. The most characteristic of these were the cadmium, zinc, and copper salts, which were submitted to analysis, and found to be true thiophosphodiamates of these metals respectively; and from these numbers the composition of the acid itself was deduced, since it was found impossible to isolate the latter either by digesting the silver precipitate with hydrochloric acid or by decomposing the copper salt with sulphuretted hydrogen. The authors state that Hugo Schiff* had previously made experiments upon the action of ammonia on the sulpho-chloride, and had correctly described the physical changes; but, in the absence of analyses, had been led into erroneous speculations regarding the nature of the chief product. He predicted the formation of sulphosphotriamide,



but this has not been established by the authors' results. If, instead of submitting the sulphochloride of phosphorus to the action of ammonia gas, it be brought into contact with aqueous ammonia, the water takes part in the reaction, and there is produced, besides chloride of ammonium, the ammonium-salt of another acid called thiophosphamic acid, and having the formula



the cadmium and lead salts of which were analysed for the purpose of establishing its composition. The reaction expressing this change was described thus:—



The PRESIDENT, in proposing a vote of thanks to the authors, remarked upon the complexity of the compounds just described, and stated his conviction that the Society would be glad to hear an account of Dr. Gladstone's further and unpublished researches.

Dr. HOFMANN inquired whether the authors had examined the action of sulphochloride of phosphorus upon aniline, the latter substance giving frequently rise to the formation of compounds the investigation of which, owing to their superior crystallising power, presented less difficulty than that of the corresponding ammonia derivatives.

Dr. ODLING considered the authors' views to be quite orthodox; they had a parallel in the formation of chlorocyanuramide.

Dr. J. H. GLADSTONE said that, although most of his precipitates were flocculent and amorphous, the cadmium salt showed a disposition to crystallise. He had not himself examined the aniline reaction, but all M. Schiff's statements regarding the action of ammonia were correct. His theory alone was bad, for he had never analysed the compounds.

At this stage of the proceedings the President vacated the chair, which was thereupon taken by Professor Graham.

The PRESIDENT then delivered a short discourse "On Chemical Nomenclature and Notation." The lecturer commenced by referring to the unsatisfactory condition of chemical nomenclature at the present time, when each author felt himself at liberty to adopt a system of his own, which became intelligible to his readers only after a careful study of the formulæ and critical examination of the simpler equations. Such was the state of confusion that it was deemed advisable by the Council, during the last session, to appoint a committee to inquire into and report upon the whole subject; and as a member of this committee, he felt somewhat diffident in appearing before the Society in an individual capacity. The committee had held a few meetings and made some progress, but was not likely to bring its labours to a definite point. In the meantime, being a teacher of chemistry, compelled to work, and now engaged in writing an elementary treatise,

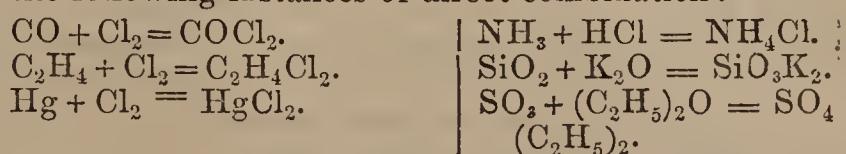
he could no longer forbear coming before a general meeting of chemists and asking their advice upon this fundamental topic. That which he now proposed to discuss was not a novel system, but an attempt to establish a ground of general agreement upon which afterwards a superstructure might be raised. He considered that the introduction of new words which had not been adopted was productive of much evil, and many old words had been used with an entirely new signification, but if a good system of nomenclature were once devised it would lend powerful aid to thought. There were, perhaps, no words in use among chemists of which the original meaning was so clear as the words acid and base. They were introduced to describe bodies of opposite properties, which were more or less completely lost in the salt, or compound of acid and base. The process of combination was, no doubt, judged from the simple cases of it which had been investigated, and in which, by the juxtaposition of two molecules, one molecule of the compound was produced, thus—



Later research showed that two molecules might, by chemical combination, form two molecules of the product. Thus—



In a similar manner we now know that one molecule of alcohol does not contain one molecule of ether united to one of water, but that two molecules of alcohol are formed by such combination. Several reactions originally supposed to be simple combinations have been proved to be cases of double decomposition, and Laurent and Gerhardt have been among the most active of modern chemists in advancing this method of explanation; but one of them fell into the error of asserting that this was universally the case, and applied the term acid to hydrogen salts, gave the name anhydride to acids, and left bases, however anhydrous they might be, without a name! The author denies the right to use a well-established name in any other than its original signification, unless the most conclusive proof can be advanced as showing that the word will not be again wanted for its original purpose. Gerhardt was no doubt sincere in his belief that compounds of fundamentally opposite properties, usually denoted by the words "acid" and "base," did not unite to form one or more molecules of a comparatively neutral compound; and, thinking the idea obsolete, did not hesitate to adopt the word acid, and use it in a modified sense as part of his own general scheme. In illustration of the fact that two molecules may unite to form one complex molecule, Professor Williamson quoted the following instances of direct combination:—



The author conceives that the oxide of lead is an active base at high temperatures, because it so readily passes into the fluid condition, which is necessary to promote contact with an insoluble acid body upon which it is made to act. In the same way water is considered a menstruum, and by virtue of its fluidity, and the solvent power which it is able to exert, it brings the particles into absolute contact, so that a union may be effected which is often otherwise impossible, as with the so-called "anhydrides," for instance, from the fact of their being in an unsuitable physical condition. For these among other reasons Professor Williamson believes that the bodies misnamed "anhydrides" are true acids, and asserts that the hydrogen salts cannot with propriety be called "acids." Of the compounds of hydrogen with chlorine and bromine it would not be incorrect to say that they have acid properties without being in themselves acids; in fact, they may be viewed like most of the known compounds of indifferent or neutral metals, which are acid in their properties with-

* *Annal. der Ch. u. Pharm.*, CI., 303.

out being really acids. The ferric, stannic, and auric chlorides are in this category, and the hydric chloride is another normal salt of very acid properties. *Acid salts* are those which contain in each molecule an excess of acid, for example—

$S_2O_7H_2, S_2O_7K_2$, &c., are acid sulphates;

$Cr_2O_7K_2$ is an acid chromate;

$P_2O_7H_4$ and $P_2O_7Na_4$ are acid phosphates.

Basic salts are such as contain the elements of a base added to those of a normal salt; for example,—

$PbCl_2, PbO$, and $HgCl_2, HgO$.

But the bismuthic oxychloride, $BiOCl$, uranic oxysulphate, $UO(SO_4)_2$, are not to be called "basic salts." There has always been much ambiguity respecting the names applicable to the two chlorides of mercury, that which is soluble being called sometimes the protochloride, and at other times the bichloride, accordingly as the atomic weight of mercury is taken as 100 or 200. The author proposes to get over this difficulty by recommending the universal adoption of the names employed in Gmelin's "Handbook of Chemistry," and calling them the "mercurous" and "mercuric chloride" respectively; and for other combinations a similar nomenclature, if generally introduced, would prove of great advantage. The President then proceeded to define the exact meaning of the terms *atom*, *molecule*, and *equivalent*. An "atom" is the smallest quantity of an element, or group, which can be conceived to take part in any reaction. The word "molecule" is only used to express the smallest quantity of an element, radical, acid, base, salt, or other compound, which can exist by itself out of combination. An "equivalent" is that weight of a body which corresponds, or is equivalent, to one atom of hydrogen, and may be expressed in this notation by a compound symbol, which shows, by a figure below, the value of its atomicity, thus:— $\frac{O}{2}, \frac{N}{3}, \frac{C}{4}$ are equivalents of oxygen, nitrogen, and carbon respectively. A few examples will render the application of these principles more intelligible; thus:—

H =	1	represents an atom of hydrogen.
O =	16	" " oxygen.
N =	14	" " nitrogen.
C =	12	" " carbon.
CH ₃ =	15	" " methyl.
CN =	26	" " cyanogen.
C ₂ H ₄ =	28	" " ethylene.
NH ₄ =	18	" " ammonium.
CO =	28	" " carbonic oxide.
SO ₂ =	64	" " sulphurous acid.
Hg =	200	" " mercury.

The molecules of chlorine, oxygen, nitrogen, phosphorus, arsenic, zinc, mercury, and cadmium are thus expressed—

$Cl_2, O_2, N_2, P_4, As_4, Zn, Hg, Cd$;

and the molecular formulæ of radicals thus—

$NH_3, C_2H_4, (CH_3)_2, (CN)_2, (NH_4)_2$.

Examples of molecules of bases, thus—

H_2O , water, or hydric oxide
 K_2O , potash, or potassic oxide
 Cu_2O , cuprous oxide
 CuO , cupric oxide
 $(NH_4)_2O$, ammoniac oxide
 Bi_2O_3 , bismuthic oxide
 Fe_2O_3 , ferric oxide
 K_2S , potassic sulphide
 $(C_2H_5)_2O$, ethylic oxide
 C_2H_4O , ethylenic oxide

Formulæ denoting molecules of acids, thus—

N_2O_3 , nitrous acid
 N_2O_5 , nitric acid
 I_2O_5 , iodic acid
 I_2O_7 , periodic acid

CO_2 , carbonic acid
 SiO_2 , silica, or silicic acid
 B_2O_3 , boric acid
 $(C_2H_3O)_2O$, acetic acid
 $C_4H_4O_3$, succinic acid

Formulæ representing molecules of salts, thus—

HNO_3 , hydric nitrate
 $Fe(NO_3)_2$, ferrous nitrate
 $Fe_2(NO_3)_6$, ferric nitrate
 $Fe_2(SO_4)_3$, ferric sulphate
 H_2SO_4 , hydric sulphate
 $HKSO_4$, hydro-potassic sulphate
 H_3PO_4 , hydric phosphate
 Al_2Cl_6 , aluminic chloride
 HCl , hydric chloride
 $FeCl_2$, ferrous chloride
 $PtCl_4$, platinic chloride

With reference to the last-named substance, Professor Williamson remarked that he had not yet heard it called the "tetrachloride of platinum," which chemists of the Gerhardt school were bound to do in order to act consistently. The author continued his account by displaying the formulæ of a number of minerals, and by showing the application of these principles to the classification of the phosphates, the numerous oxides of manganese, and the organo-metallic bodies; and concluded by laying down some good rules as a guide for the use of plus and minus signs, brackets, &c.; and stated his opinion that the order of arrangement of the elements in a formula should be one of convenience only, thus—

$Ag(NO_3) + ClK$

would convey to his mind the simplest expression of the manner in which argentic nitrate was supposed to react upon potassic chloride; and he would use indifferently the symbols KCl , or ClK , as might be most convenient for the purpose in view. The sign of addition, + should never be placed inside a molecule, but be employed to indicate that different substances were added or brought together, and $H_2SO_4 + KNO_3$ means that 98 parts by weight of hydric sulphate are to be mixed with 101 parts by weight of potassic nitrate, or in the proportion of their molecular weights. Respecting vapour-volume, chemists had already agreed to adopt as a unit the volume of 16 parts by weight of oxygen, and the author found it convenient in teaching to take an absolute measurement which could be employed as a starting point in calculations. Professor Williamson's standard volume is 11.19 litres (or 11.2 for all practical purposes), which is the bulk of 16 grammes of oxygen at $0^\circ C.$, and 760 millimetres pressure. With the aid of this number and the molecular weight of volatile bodies it was easy to calculate the bulk of any given weight in practical problems.

Professor GRAHAM felt sure the Society would appreciate the President's endeavours to place the chemical theory upon a more substantial foundation: for his own part, he felt disposed to acquiesce in every one of the President's suggestions.

Sir BENJAMIN BRODIE thought that instead of perfecting our systems of nomenclature it would be better to get rid of them altogether. The latest efforts in this direction were anything but successful; old substances were called by new names, and such was the perversion of the present age that it now took him a long time to identify the bodies upon which he had himself worked, and he felt certain that his friend, Dr. Hofmann, would often be unable to recognise his own creations. If it were possible to use the symbol for the word, as in the operation of thinking, great would be the advantage. Chemistry was now passing through a phase in its history which other sciences had already gone through: for instance, in mathematics, when curves were few and simple it was possible to attach to each a distinct name, but now the curves had grown

beyond the reach of language mathematicians were obliged to divide them into classes, and describe them by giving the equation. He agreed with many of the President's remarks, particularly in his definitions of the atom and molecule, but he would ask what constitutes an acid? Whether carbonic oxide could be distinguished from formic acid? [The President here wrote on the board $C_2H_2O_3$ as the formula of formic acid.] He would prefer to dispense with the term "acid," and merely describe the body as the teroxide of sulphur, the deutoxide of sulphur, &c.—simple names which implied very little theory. Anhydrous acetic acid he usually regarded as the oxide of acetyl. In his opinion, it would be better to leave the consideration of these questions to individual effort and research, and not entrust them to a committee, who would have no power to enforce upon others the adoption of their own theoretical opinions.

Dr. HOFMANN said that he had listened with the greatest interest to the important proposals made by Professor Williamson, whose remarks reflected many difficulties which in his lectures he had frequently himself experienced. He had no doubt that many of the President's suggestions would be gladly accepted by his brother chemists; he did not, however, think that his proposal to restore the term "acid" to the anhydrides would meet with the easy acquiescence of those who had consistently vindicated this appellation to the hydrates. Like Professor Williamson, and probably like most teachers, the speaker had frequently felt how desirable it would be to have a simple and easily-definable ratio between the volumes and weights of gaseous bodies. Professor Williamson had pointed out that the weight of 12 litres of oxygen under the normal conditions of temperature and pressure was very nearly 16 grammes. For years past he had been in the habit of putting the ratio of volume and weight before his students in another form. The cubic centimetre of water at 4° C. being 1 gramme, the specific gravity of solids and liquids being invariably referred to water, expressed the absolute weights of 1 c.c. of the several substances. In considering the absolute weights of gas-volumes, it was very desirable to adopt in a similar manner, a weight-unit for gaseous substances, the weight under normal conditions of temperature and pressure of 1 c.c. of hydrogen, this gas having, by universal consent, become the standard of comparison for the specific gravity of gases. Not having as yet arrived at that angelic condition of existence in which names were no longer necessary—a state of things graphically described by Sir Benjamin Brodie that very evening—he had found it convenient to adopt a special name for this weight unit, and he had named it *crith* from *κρίθη*, barley grain, with the secondary signification of a very small weight; a word, they would perceive, constructed somewhat upon the plan of the Latin *granum* or the English "grain." The word "crith" admitted of combinations very similar to those of gramme. 1 kilocrith was the weight of 1000 c.c. = 1 litre of hydrogen, exactly as 1 kilogramme was the weight of 1000 c.c. = 1 litre of water. It was obvious, then, that read in kilocriths, the specific gravity of gases represented the absolute weights of 1000 c.c. = 1 litre of these gases at 0° C. and 0.76 pressure. 1 litre of chlorine gas weighed 35.5 kilocriths; 1 litre of oxygen, 16; 1 litre of nitrogen, 14; 1 litre of carbonic acid gas 22 kilocriths. Again, the molecular weights of compounds, read in kilocriths, represented the weights of 2 litres of these compound gases; 36.5 kilocriths was the weight of 2 litres of hydrochloric acid, 18 that of 2 litres of steam conceived to exist at 0° C.; 17, the weight of 2 litres of ammonia. Molecular formulæ of compounds such as HCl, H_2O and H_2N ; and even of elements such as HH, ClCl, OO all represented no longer generally the weight of 2 volumes, but the weight of 2 litres of the gases under normal conditions expressed in kilocriths. Indeed, the 2 volume formulæ became 2 litres

formulæ. The value of the kilocrith was easily remembered; it was 0.0896 (very nearly 0.09, or less accurately $\frac{1}{11}$ th) gramme. The speaker had found the conception of abstract 2 volume formulæ greatly facilitated by this link of transition.

Dr. MILLER was ready to admit that the word "acid" had been employed in two significations. We now distinguish between anhydrides and acids (or salts of hydrogen); it would be difficult, he thought, to go back to the use of the term "acid" as being applicable to bodies destitute of hydrogen, and in that case there would be a notable exception in hydrochloric acid.

Dr. FRANKLAND agreed with Sir B. Brodie in the opinion that it would be better to term them oxides only. With regard to the termination "ic," he would prefer that this should be reserved for compounds of greatest atomicity; and in the case of metals having but one basic oxide, he proposed that the salt or other compound should bear the name of the metal without alteration—thus, "sodium sulphate."

Mr. NEWLANDS spoke of the confusion arising from the use of the term "acid" in two senses; it would be well to call sulphuric acid the "sulphate of hydrogen." The speaker advocated the adoption of a type system, such as he had already explained in a contribution to the CHEMICAL NEWS.

Dr. ODLING considered that, with deference to Sir B. Brodie's opinion, the recent attempts at nomenclature had been successful, and Dr. Hofmann's results were good proof of this being the case. He believed the retention of the word "acid," in a modified sense, to be perfectly justifiable, and was a natural consequence of the growth of definition.

Dr. PAUL could not allow that the original view respecting acids comprised anything more than the sour taste, power of reddening vegetable colours, and of neutralising alkalies. He regarded as disastrous the use of one word to express two distinct ideas, and referred to a want of concordance in opinion as to the exact meaning of the words "dry," "acid," "equivalent," &c.

The PRESIDENT, understanding that Professor Hofmann had come prepared to show them an experiment on combustion, proposed that a portion of the next ordinary meeting should be devoted to the further discussion of his communication, which he was anxious to have fully criticised before replying to the objections brought against it.

Having been put to the vote, this course was accordingly adopted.

Dr. HOFMANN, having been reminded by the Secretary that at the last meeting he had promised them an experiment, replied that after the important matter discussed that evening, and at the late hour, it was with reluctance that he addressed the Society. He had, however, heard that the Olympian gods, after diligently attending to their celestial business, were occasionally pleased to come down upon earth and to indulge in the pursuits and amusements of ordinary mortals. These Olympic traditions had been happily revived in the Chemical Society, by Mr. Septimus Piesse. The descent of the gods used to take place in a cloud of lightning. They would remember that at the conclusion of the last meeting Mr. Septimus Piesse had furnished them with a cloud; although late in the evening, he begged permission to supply the lightning. Dr. Hofmann then exhibited some *small paper matches*, which were lately given to him, and said to have been brought home from Japan. He lighted several of these matches, which burned with a small, scarcely luminous flame, a red-hot ball of glowing saline matter accumulating as the combustion proceeded. When about one-half of the match had been consumed, the glowing head began to send forth a succession of splendid sparks. The phenomenon gradually assumed the character of a brilliant scintillation very similar to that observed in burning a steel spring in oxygen, only much more delicate, the indi-

vidual sparks branching out in beautiful dendritic ramifications. His first idea, Dr. Hofmann continued, had been to look for a finely-divided metal in the mixture. But when examined in his laboratory it had been found quite free from metallic constituents, and to contain carbon, sulphur, and nitre only. These constituents were present in the following proportions:—Carbon, 17.32; sulphur, 29.14; nitre, 53.64. Each match contained about 40 milligrammes of the mixture, which was folded up in fine paper. There had been no difficulty in imitating these matches. A mixture of carbon 1 (powdered wood charcoal), sulphur $1\frac{1}{2}$, and nitre $3\frac{1}{4}$, produced the phenomenon in even a more striking manner. The choice of the paper was not without importance. Ordinary English tissue-paper might be used. The finest matches were, however, obtained by employing genuine Japanese paper, a supply of which had been recently forwarded to him by Baron Magnus, of Berlin. In conclusion, Dr. Hofmann said that, owing to its delicacy, the phenomenon was better adapted for individual observation than for exhibition before a large audience. He had, therefore, prepared a number of these matches, which were distributed among the members of the Society.

The meeting was then adjourned until Thursday, January 19.

PHARMACEUTICAL MEETING.

Wednesday.

Mr. HILLS, Vice-President, in the Chair.

(Continued from page 295.)

THE next paper was by Mr. HASELDEN, "*On Extractum Krameriaë*." This extract the author considered of some interest to notice, since it was new to London and Dublin pharmacutists. For some years there had been a great scarcity of the genuine Peruvian krameria, and a year ago it was not to be obtained at all. The author had, therefore, thought it advisable to compare the preparations made with true Peruvian rhatany, and those made with rhatany imported from Savanilla, a port of New Granada, which was obtained from a different species of krameria. The process of the Pharmacopœia Mr. Haselden considered good, and he believed that there was little or no difference in the value of the two roots. Two pounds of the Peruvian root yielded three and a-half ounces of astringent extract. Two pounds of Savanilla root yielded four and a-half ounces of extract as astringent as the former. The mares in both cases gave only a tasteless extract, showing that the root had been perfectly exhausted in the process. The extract must be evaporated to dryness, or it becomes mouldy. It is soluble in cold water, and in spirit of wine. A tincture made according to the British Pharmacopœia from Peruvian root has the specific gravity .932; while that from Savanilla root is rather higher—.933. A fluid ounce of the former yielded 14 grs. of dry extract; the same quantity of the latter gave 15 grs. of extract. That made from Peruvian root has a rather deeper colour, but the author considered that the Savanilla root was quite equal to the Peruvian as a remedy. In cases of adulteration by logwood, perhaps bichromate of potash might be useful as a test.

Professor BENTLEY was glad to hear Mr. Haselden confirm a statement he had for some years made in his lectures,—namely, that the Savanilla root was as good as the Peruvian; and he regretted that both had not been placed in the British Pharmacopœia. The Peruvian has been very scarce for some years. The two roots were easily distinguished. Peruvian rhatany root was fibrous, and the bark was adherent, while the Savanilla had a close texture. The botanical source of the two roots was open to discussion.

Mr. HANBURY inquired whether the Peruvian of commerce was of the long, finer kind?

Mr. HASELDEN replied that there was none of that kind to be had until recently.

Mr. HANBURY said he thought that Savanilla root was richer in matter soluble in spirit than Mr. Haselden had shown. Eight or ten years ago, when Savanilla root was first imported, Guibourt had made experiments with it, and thought it was superior to Peruvian. He himself felt no hesitation in employing the one for the other.

Mr. HASELDEN then read another paper "*On Extractum Lupuli*." In this instance also he thought the process of the Pharmacopœia good, although the quantity of spirit might perhaps be increased with advantage. The first operation with 1 lb. of hops yielded an ounce and a half of soft extract. The second operation gave two and a-half ounces, making together four ounces of a soft extract which had a fine odour and an intensely bitter taste. More might probably have been obtained from the marc. By the process of the old London Pharmacopœia a rather larger quantity of extract was procured. By that process the hops yielded 30 per cent. of extract, but by the new only 25 per cent. was obtained; the new extract, however, was superior in aroma and taste. Sixteen ounces of the spirit, very agreeably flavoured by the hop, was recovered in the distillation directed by the British Pharmacopœia.

The CHAIRMAN suggested that extract of hops should always be prepared with hops which had not been sulphurised. The growers had a practice of doing this to improve their appearance, but the practice was prejudicial, inasmuch as the sulphurous acid must, to some extent, destroy the aroma.

Professor REDWOOD thought that there might be a different reason for sulphuring than that stated by the Chairman. The practice was perhaps found useful in destroying the insects which often infected the plants, and thus the practice might have some advantage in preserving the hops.

The meeting was afterwards adjourned until January 4, 1865, when Dr. Attfield will read a paper "*On Perchloride of Iron and its Solutions, and the Various Processes for its Preparation*."

ACADEMY OF SCIENCES.

December 12.

M. CHEVREUL presented an "*Historical Note on the Different Ideas entertained with regard to Air in Relation to the Composition of Bodies*"—before, we may add, the discovery of oxygen. There is nothing in the note but what is well known.

M. E. Gueymard presented a memoir "*On the Analysis of various Leaves and some Plants*." The author commences:—"Since in agriculture nothing should be lost, I have thought that one might make some use of the leaves of trees." He then proceeds to answer the question—"Should leaves be considered as manure?" To which he replies, Yes. He subsequently gives analyses of the ashes of thirty-seven kinds of leaves, branches, &c., and specially praises potato halm as a manure.

Fatal Explosion.—Mr. Crowther, "dealer in oxygen and hydrogen," Peter Street, Manchester, and his son were killed on Saturday last by the explosion of an iron retort, in which the father was making oxygen from a mixture of binocide of manganese and chlorate of potash, or what he had bought as such. At an inquest held on his body, however, a verdict of manslaughter was returned against Mr. E. G. Hughes, druggist, Cateaton Street, who had sold the mixture the deceased was operating with, which mixture was analysed by Dr. Roscoe, and found to be composed of manganese, chlorate of potash, and something that was either soot, lamp-black, or charcoal. Such a mixture, Dr. Roscoe said, would be as explosive as gunpowder.

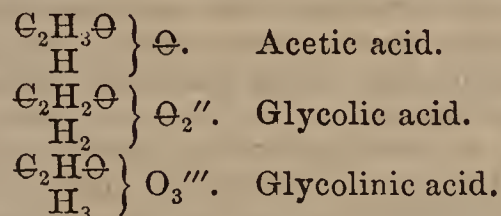
NOTICES OF BOOKS.

A Manual of Materia Medica and Therapeutics ; including the Preparations of the British Pharmacopœia, and many other Approved Medicines. By J. FORBES ROYLE, M.D., F.R.S., and F. W. HEADLAND, M.D., &c. London: Churchill and Sons. 1865.

THIS is the manual of the late Dr. Royle, brought down, as the title indicates, to include the preparations of the British Pharmacopœia, and that is all we can say of it. In some respects the present contrasts unfavourably with the last edition. It is scarcely so well printed, and is not so well bound as the last.

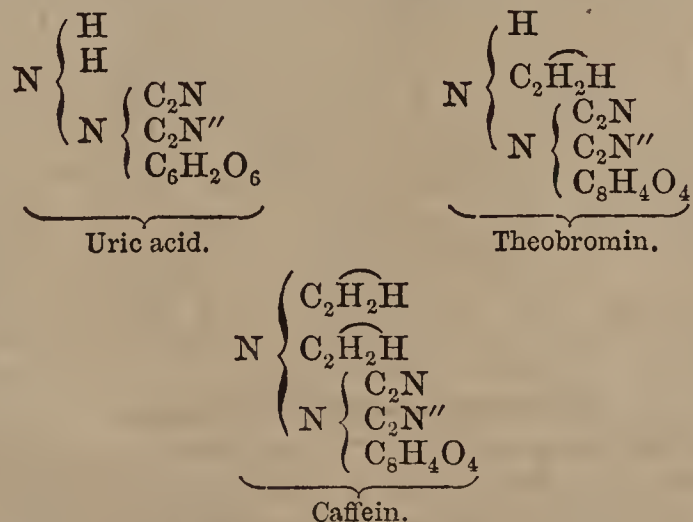
Journal für Praktische Chemie. No. 18. 1864.

THE first paper is by Dr. Friedlander, "*On Glycolinic Acid.*" The author took oxalethylic ether, diluted it with three times its weight of absolute alcohol, and shook the mixture with sodium amalgam. The mixture became milky, and after the sodium amalgam had been renewed several times it became grey, and towards the end the liquid was thick and syrupy, and lastly solid. In this way he obtained the soda salt of a new acid— $\text{NaO}, \text{C}_4\text{H}_3\text{O}_7$ —the acid of which he names Glycolinic acid. This acid was separated by treating a solution of the soda salt in dilute alcohol with an alcoholic solution of oxalic acid. The new acid forms a white crystalline powder, which, like all the salts it forms, is easily soluble in spirit and in water. The author regards it (although monobasic) as the triatomic acid of the acetic series:—



Several of the salts of the acid are described.

Another paper is by Rochleder, "*On the Constitution of Caffeïn and Theobromin.*" He compares the constitution of these bodies with that of uric acid. He considers this last named as a derivative of tartronyl, and in caffeïn two equivalents of methyl stand in the places of the two equivalents of hydrogen of that radical, and in theobromin one equivalent of methyl and one equivalent of hydrogen. Their formula may therefore be written as follows:—



Caffeïn and theobromin, however, he says, cannot be tartronyl-, but must be succinyl compounds.

The formulæ show that in uric acid two equivalents of hydrogen, and in theobromin one equivalent of hydrogen, are replaceable by a metal, but in caffeïn none is replaceable. The paper offers a curious study in formulation, and shows the advantages of using the formulæ of bodies instead of their names, as suggested by Sir B. Brodie.

The next original paper we find is by Hermann, "*On the Separation of Thoria from Oxides of the Cerium Group, and on the Composition of Monazite.*" This mineral is a

phosphate of thorium, cerium, didymium, and lanthanum. The author fused it with hydrate of soda, dissolved the fused mass in sulphuric acid, and boiled the mixed sulphates with hyposulphite of soda, whereupon hyposulphite of thoria separated. This salt when ignited leaves pure thoria behind as a light white powder, like magnesia.

The other papers in the journal have already been noticed or published at length in the CHEMICAL NEWS.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2913. William Ibotson, Wraysbury, Buckinghamshire, "Improvements in the preparation of pulp for the manufacture of paper."

2916. Jean Claude Louis Durand, Montée des Vierges, Roche Cardon, Lyons, France, "Improvements in the manufacture of colouring matter, and in treating fabrics and materials dyed or printed therewith."—Petitions recorded November 22, 1864.

2953. Leandro Crozat, Seville, Spain, "Improvements in photographic process, and in portraits or images produced thereby."—Petition recorded November 25, 1864.

2073. Carl Johan Falkman, St. Petersburg, Russia, "Improvements in apparatus for distilling and purifying spirituous liquors, also applicable to the purification of other volatile fluids."—Petition recorded November 29, 1864.

2981. Richard Farrall Dale, Shoe Lane, London, "A new apparatus to be employed in drawing off and measuring paraffine and other oils, applicable also in drawing beer and other liquids, and measuring the same."

2985. Henry Caunter, Stornaway, Island of Lewis, N.B., "Improvements in preserving ships' bottoms and other surfaces under water, and in preventing the formation of barnacles and other accumulations thereon, which improvements are also applicable as a preservative from the effects of moisture or damp, and as a cure or preventive of the scab in sheep, and a protection to them from the effects of damp and exposure."—Petitions recorded November 30, 1864.

2832. George Edward Noone, George Street, Hastings, Sussex, "Improvements in machinery for deodorising and utilising the sewage of towns, and in the treatment of other refuse to be combined therewith, both liquid and solid, for manure and chemical use."—Petition recorded November 14, 1864.

2852. Arthur Wall, Clapton, Middlesex, "An improved combination, or improved combinations of materials to be used as fuel."—Petition recorded November 15, 1864.

2894. William Virgo Wilson, Jubilee Street, Mile End, and James Alfred Wanklyn, Finsbury Circus, London, "Improvements in the preparation of purple dye-stuffs."—Petition recorded November 19, 1864.

2923. Francis Millns, Poole, Dorsetshire, "An improved method of cooling liquids, particularly applicable to the cooling of wort."—Petition recorded November 23, 1864.

2937. John White, Finchley, Middlesex, "Improvements in means or apparatus employed in purifying, changing the temperature, and impregnating atmospheric air, which improvements are also applicable to the purification or separation of gases or vapours, and part of which improvements is also applicable in obtaining motive power for other purposes."—Petition recorded November 24, 1864.

2948. Lois Leisler, Glasgow, N.B., "Improvements in obtaining bromine and bromides, and in apparatus therefor."—Petition November 25, 1864.

3035. William Thomas Watts, Birmingham, Warwickshire, "Improvements in apparatus to be applied to furnaces for condensing and collecting products volatilised

in the said furnaces."—Petition recorded December 6, 1864.

Notices to Proceed.

1950. Giacomo Felice Marchisio, Baker Street, Middlesex, "An improved apparatus for generating inflammable air for illuminating and heating purposes, and applying the same to the burners."—Petition recorded August 4, 1864.

2031. Richard Archibald Brooman, Fleet Street, London, "Improvements in the manufacture of cast steel."—A communication from Francois Marie Emilie Martin, and Pierre Martin, Paris, France.—Petition recorded August 15, 1864.

2675. Alexander Parkes, Birmingham, Warwickshire, "Improvements in manufacturing compounds of gun-cotton and other vegetable substances similarly prepared; also in the preparation of castor and cotton oils and gum ballata, to be used with, or separate from, such compounds."—Petition recorded November 14, 1864.

2973. Carl Johann Falkman, St. Petersburg, Russia, "Improvements in apparatus for distilling and purifying spirituous liquors, also applicable to the purification of other volatile fluids."—Petition recorded November 29, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, December 20.

THE use of the magnesium light in photography is exciting a good deal of attention here, and M. Matthieu-Plessy has effected an improvement in the magnesium lamp, which deserves your notice. At the last meeting of our Photographic Society, that gentleman exhibited a very excellent lamp—made, I believe, by Mr. Solomons,—which will prove of much use to photographers, and which, by the way, is susceptible of adaptation to many useful purposes. But under the best of circumstances the magnesium does not always burn evenly, and sometimes goes out at a critical moment. M. Matthieu therefore suggests that the magnesium wire or ribbon should be delivered into a fixed flame of a kind that will not interfere with the photogenic properties of the light, and with this object he uses a small hydrogen flame. You will see that nothing can be easier than to adapt an arrangement of this kind to Mr. Solomon's lamp, which, without it, is an excellent instrument.

You have recently, I see, given some account of Niepce's latest results in chromatic photography, so I need not allude to them further than to say that this eminent photographer has, if all be true, been completely distanced by a rival experimenter in the Mauritius, M. Chambay. The information comes a long way, but who can doubt the truth of it, seeing that it is to be found in a newspaper, the *Cernéen*, published at Port Louis?—and do not all newspapers, the CHEMICAL NEWS included, tell the truth, the whole truth, and nothing but the truth? I will translate a sentence or two:—"M. Chambay has succeeded in fixing colour; the picture is taken instantaneously; the relief and modelling of the figure are marvellous; life circulates under the skin; the colour is unchangeable; and the portraits offer an almost incredible resemblance to the originals. . . M. Chambay is going to Paris with his process, where it will certainly make a revolution." That it will.

Another thing which is attracting considerable attention in Paris just now is the adaptation of electricity to the production of motive force. We have two inventions, one by Count Molin, to which M. Babinet stands sponsor. This is proposed for a boat-propeller, whether by a screw or paddles is not said. I have no details of this scheme, but M. Babinet reports strongly in favour of it. I have little doubt that in the main features it resembles another

invention by MM. Bellet and Rouve, who are exhibiting at Versailles a small locomotive driven by electricity. This certainly merits some attention, since the inventors do not seem to claim any extraordinary powers for their machine. They only propose it for carrying light weights, such as letters, by an underground railway; and so it may deserve the notice of some people in London, if Mr. Rammell should fail to raise wind enough to drive his carriages through the Pneumatic Dispatch tubes. The driving-wheel of the engine is made of copper, through which at equidistant intervals pass a series of horse-shoe electro-magnets—twenty in the whole circumference. The current is made to pass successively through these magnets, contact being made and broken by means of two discs at the axis of the wheel. The iron rail attracting these magnets causes the rotation of the wheel, and, in the absence of great weight, the progression of the vehicle at an extraordinary speed. I need not go into the details of the arrangements, since any of your readers acquainted with the subject of magnetism will immediately see what they must be. The batteries, I ought to say, are placed at the termini to save the weight in the carriage, and the current is conveyed by insulated wires running between the rails, and over a roller in the locomotive, which communicates with the interrupting apparatus. A small machine exhibited by the inventors succeeds perfectly, and the plan seems feasible on a larger scale.

I have only one other scientific application to notice, and that is the arrangements for the chimes at the belfry to the Church of St. Germain l'Auxerrois. Chimes are usually melancholy affairs—at all events, for those who live in the neighbourhood of them. That one air played four or six times every day for long years must become wearisome, unless upon some particular occasion, as when the chimes of the old Royal Exchange played "There is nae luck about the house" while the greater part of the building was in flames; or at a country church I remember in England, where "Life let us cherish" is played in the middle of a very large graveyard. Well, M. Colin is about to make the chimes of St. Germain l'Auxerrois lively. They will consist of forty bells, and are to play twice a day, and a new air each time; that is, within certain limits, for, as you know, every new tune requires a new barrel. But M. Colin has invented cheap and light barrels, which are easily made and changed, and will cost only about 250 frs. each. The single barrel of the celebrated chimes at Bruges cost, it is said, 60,000 frs. By means of one of Lenoir's gas-engines the inventor compresses air into a reservoir to a pressure of $2\frac{1}{2}$ atmospheres, and acts on the hammers of the bells by letting out this compressed air. The same gentleman is also trying to adopt electricity as a moving force for the hammers, which, though not perhaps impossible, would be a complicated business.

A report of the Surgical Society of Paris on the construction and arrangements of hospitals has just been published, which may deserve notice in England. The hospitals of Paris are notoriously unhealthy; hardly a patient recovers from a severe operation, and the fatality in all cases is much greater than in the London hospitals, which are far from being what they might be. The recommendation to have a series of detached buildings instead of one huge pile, is, I think, especially worthy of attention, while all the rest are eminently practical and valuable.

"Our Inheritance in the Great Pyramid."

To the Editor of the CHEMICAL NEWS.

SIR,—Having read with much pleasure Professor C. P. Smyth's interesting work entitled "Our Inheritance in the Great Pyramid," and also your review of the same in the last number of the CHEMICAL NEWS, I beg to assure you of my entire concurrence in the favourable opinion you have been pleased to express with regard to

this work. At the same time I feel it my duty to point out a couple of errors which you appear to have overlooked, and in directing attention to them I am actuated only by a desire to see correctly stated all the data upon which such important conclusions have been deduced. The *errata* to which I refer are to be found at page 210, where it is stated that the ounce avoirdupois contains "427.5 grains," and the drachm $\frac{1}{16}$ th part of this amount, or "26.71875 grains." These numbers should have been 437.5 and 27.34375 respectively. The first I thought was a mistake for which the printer alone was responsible, but as the avoirdupois drachm had been calculated upon the false basis of 427.5 grains to the ounce, it became then evident to me that the inaccuracy must have occurred in the original manuscript; and I send you notice of it in order that so good a book may be purged from errors in themselves trifling and obvious, and which can easily be corrected in a future edition. I am, &c.

December 19.

F.C.S.

[The errors herein alluded to did not escape our observation, but were not pointed out in the review, inasmuch as the avoirdupois weights were enumerated only in a table of comparison, and did not constitute an integral part of Professor Smyth's system.—ED. C. N.]

MISCELLANEOUS.

RENARD *v.* LEVINSTEIN.*

Before Vice-Chancellor Sir W. P. Wood.

MR. GROVE, Q.C., opened the plaintiff's case with a brief review of previous proceedings, in the course of which he replied to objections which had been brought against the validity of the patent in dispute.

The first witness called was M. Girard, one of the plaintiffs, who was examined through an interpreter. In answer to questions put by Sir Hugh Cairns, he said that the blue dye in question was the joint discovery of himself and M. De Laire, who worked together with him in the laboratory of the French Mint. The name of the latter gentleman did not appear in the English patent, because he was ill, and unable to come to England at the time it was taken out. At the time the patent was taken out red aniline dye was known in England and France in the solid and liquid form, but better known as a solid. That red aniline would produce the blue if sufficiently purified. To the best of witness's belief the blue dye was new at the time. The quantity of the blue dye made since the patent was taken out was worth from 80,000*l.* to 120,000*l.* All this was made according to the specification, with the exception of a slight modification of the process made at the end of 1862. The modification was in the mode of heating.

Cross-examined by Mr. Jessel: Witness was not in the employment of the French Government when he worked at the Mint. He was pupil of M. Pelouze, who did not give him any information about the aniline dyes. M. De Laire and himself worked on them alone. They were in search of new colours, and in the course of these experiments discovered the mode of making a blue. They took out three patents in France. The dye is now made in France according to the last of the three taken out, on January 2, 1862. They obtain the violet colour first, and pass from that to the blue. The violet was changed to blue by means of diluted hydrochloric acid. The process is as follows:—We take purified red aniline dye and heat it for four or five hours with aniline, and so obtain a violet mass. This, according as we wish to have a mass more or less blue, is treated with acid more or less strong. With very dilute acid for violet, and much stronger acid for blue.

In all cases the mass is boiled with the acid. All forms of red aniline dye will answer if they be purified from all foreign substances. We use the aniline of commerce, which does not contain any salt. Some chlorine may be present in the red aniline dye. We used chloride of rosaniline, and other salts as well,—acetate and sulphate, for example. We found they would all answer. We only know the composition of red aniline dyes from the labours of Dr. Hofmann, but the dyes were known before. We used chloride of rosaniline to make the blue, but at the date of the patent we did not know what it was chemically. I can tell now whether I am using the chloride by treating it with sulphuric acid. I received communications from M. De Laire while I was in England to take out the patent.

Re-examined by Sir H. Cairns: Both the French and English patents were taken out before the International Exhibition opened.

Mr. G. De Laire, examined through an interpreter by Mr. Giffard. The evidence in chief of this gentleman was simply confirmatory of that given by the previous witness. He stated, however, that the quantity of the dye they had made was worth 180,000*l.*

Cross-examined by Mr. Aston: I know now that red aniline dye is a salt of rosaniline with an organic or mineral acid. The nitrate cannot be boiled without fear of decomposition. The blue can be made from the nitrate. The arseniate will produce the blue. This salt existed, but was not known at the date of the patent. All the salts were sold as red aniline dye.

Re-examined by Mr. Giffard: As far as I know nothing was known as red aniline dye at the date of the patent which would not produce the blue dye. The substances known as red aniline dye were the chloride and arseniate of rosaniline, probably also the sulphate, and certainly the acetate. The two most commonly used were the acetate and arseniate. The nitrate is no longer known in commerce.

M. Thomas, examined through an interpreter: Is agent in England for M. Renard. Resided in Lyons in 1862, and knows that the blue dye was made in 1862 strictly according to Girard's patent.

Cross-examined: Red aniline dye was put in an iron retort with aniline, and heated for five hours. Then the melt was poured into an enamelled pan, and strong hydrochloric acid was added; a current of steam was then passed through the mixture. This process was repeated several times until the colour was produced. The melt was boiled with dilute hydrochloric acid to obtain the violet—ten parts of commercial acid and ninety parts water—this was to remove any excess of red aniline dye. When blue was wanted, a stronger acid was used. I know it was strong, because it gave off fumes. Three or four things were called red aniline dye in 1862—the acetate, oxalate, arseniate, and hydrochlorate of rosaniline. An excess of aniline is advisable in the operation. I have seen experiments made with toluidine, and saw it succeed very well.

M. B. G. Franc, examined by Mr. Russell: Is one of the firm of Renard, Brothers, of Lyons. We began the manufacture of the blue dye in April or May, 1861. We have since made 200,000 kilogrammes.

Cross-examined by Mr. Jessel: I was concerned with the sale. I know no process but Girard's. I know the works of Dr. Hofmann. In Girard's patent, no mention is made of an arseniate of rosaniline. We made our red dye by heating aniline with chloride of tin. We also made the iodide, and we made the red dye with nitrate of mercury also. In 1861 we used the chloride, iodide, and nitrate of rosaniline. All these were known as red aniline dye, but were sold under the names azaline, fuchsine, and magenta. We bought some benzoic acid, and I think used it, but very rarely. We bought large quantities of acetic acid.

M. J. F. Persoz, examined by Mr. Grove: I know the patent of Girard. The process was new at the date of the

* Our report is necessarily confined to the scientific part of the evidence. Of the personal matters in dispute we shall take no account.

patent. The substance known at that date as rouge d'aniline will produce the blue colour if it be pure. Any chemist can purify it.

Cross-examined by Mr. Jessel: The substances known as rouge d'aniline in 1861 included what is now known as the nitrate of rosaniline. The acetate and oxalate of rosaniline were sold as red dye at the same date. In crude red aniline dye there is an excess of aniline and secondary products which must be got rid of. I have tried to make the blue with nitrate of rosaniline and aniline. I must add something with the nitrate. I never used pure aniline; it always contained toluidine. I have tried toluidine mixed with aniline, and always succeeded. Commercial aniline contains various bodies, acetone being one. I cannot say that acetone is driven off at the boiling-point. I never experimented with pure aniline. The chloride of rosaniline will produce blue by Girard's process; so will the arseniate. You cannot produce a pure blue, it will have a violet shade. Blues which look so in sunlight are not so in the spectrum.

M. Cahours, examined by Mr. Giffard: I know Girard's process, and have tried it with rouge d'aniline and commercial aniline, and produced a good blue. The process, as far as I know, was new in 1861.

Cross-examined by Mr. Aston: Up to 1861, no blue had been made from aniline. There was the blue from cinchonine. I have operated upon the acetate, oxalate, arseniate, chloride, and sulphate of rosaniline to produce the blue described by Girard. In the first step I obtained a violet mass; afterwards I boiled this mass with commercial hydrochloric acid diluted with eight or ten times its bulk of water. To produce the blue I have boiled it several times.

Re-examined by Mr. Grove: To obtain the blue I employed one of hydrochloric acid and five of water. To get the violet residue, I would use one of acid to twelve of water.

Dr. Hofmann, examined by Mr. Russell: I know Girard's specification. The invention there described was perfectly new. I have made the colour by following the directions. On the 19th and 21st of last month, in company with Drs. Frankland, Noad, and Redwood, and Mr. Warrington, I made experiments to produce the blue. We used what is now known as acetate, oxalate, sulphate, arseniate, and chloride of rosaniline, and also toluidine. We tested the aniline for acetic acid. The separate salts were mixed with aniline in separate experiments. We used a heat of 165°, or a little above and below. The time required varied. The maximum was five hours. The first result was a violet mass. We then divided the violet into two portions—one to be worked for violet, the other for blue. We diluted commercial hydrochloric acid with a large quantity of water—four ounces of acid to a gallon of water, or about 2 per cent. of acid. With this we obtained the violet residue soluble in acetic acid and alcohol. The time of boiling varied; but I should say half an hour was sufficient. We then boiled the other violet with acid and water, in the proportion of one of acid to ten of water. The product had a coppery lustre, and dissolved in acetic acid and alcohol; the solution dyed silk blue. The acetate of rosaniline required the shortest heating to produce the violet mass, and the chloride the longest. In each case a good blue was produced. With toluidine the process was exactly similar.

Cross-examined by Mr. Aston: I was not aware that nitrate of rosaniline was known as red aniline dye at the date of the patent. I should say the nitrate would produce the colour, but it was not tried. I know acetanilide. I believe it is occasionally found with aniline. The same process which detected acetic acid would detect acetanilide. No acetanilide was found in the aniline we tried. The violet mass, treated as directed in the specification, will produce the blue dye. The shortest time in obtaining the blue dye was half an hour to two hours; the longest,

six hours. I cannot say whether you can produce the blue in an hour's time. I first knew acetate of rosaniline in January, 1862. I got it from Mr. Nicholson. We experimented on from two to four ounces of the mixture. I cannot say what salt of rosaniline produced most blue dye. We did not make quantitative experiments. I think the oxalate was known at the date of the patent. No doubt a manufacturer would use acetate rather than chloride.

Re-examined by Mr. Grove: At the time of the patent the distinctions between the salts of rosaniline were not known. I do not know whether the nitrate was ever used. I did not test the aniline separately for acetic acid and acetanilide.

Mr. Abel, examined by Mr. Giffard: I have experimented according to Girard's process, and have had no difficulty in arriving at the results. I have experimented with commercial aniline, and the acetate, oxalate, and chloride of rosaniline. I joined in the experiments on the 19th and 21st of November, and agree with Dr. Hofmann in his statement of the results.

Cross-examined by Mr. Aston: I do not think the double treatment of the crude violet mass is clearly described in Girard's specification. In my own experiments I tried the five salts mentioned by Dr. Hofmann. I had never seen the nitrate. I used commercial aniline, supplied to me by Mr. Nicholson. I tested it for acetic acid, but not for acetanilide. The same test would detect both. The heating to convert the violet into blue occupied an hour. We got the violet in an hour. The production of the violet was the production of the blue in the meaning of the specification. In my first experiment the heating operation only lasted twenty minutes. I have only made two experiments. Reading the specification, and using the substances known at the date as red aniline dye, I cannot tell you any means to produce the blue dye in half an hour. By operating on a large scale perhaps time might be saved.

Dr. Frankland, examined by Mr. Russell: I agree with Dr. Hofmann in his account of the experiments made on the 19th and 21st of November. I noted the time in the experiment with acetate of rosaniline and toluidine. We produced the blue in thirty-five minutes. I do not know a pure blue. I examined a considerable number of blues—aniline, prussian, indigo, and cobalt blues. They have all a shade of red. I made spectrum analyses of the plaintiff's and defendant's blues. The defendant's blue contains, in addition to the blue, a band of green and a band of red. The spectrum of the defendant's blue is the same as those of aniline blue and indigo and cobalt blues.

Cross-examined by Mr. Bagshawe: I never experimented before November 19. We did not use nitrate. When I said the blue dye was produced in thirty-five minutes I meant the violet mass. The hydrochlorate of rosaniline took the longest time. The operation lasted six hours. By the operation I mean the heating with aniline. The washing with acid had still to be done. We tested all the materials we used, which were all furnished by the plaintiffs. We tested the aniline for acetic acid, and that test would show the presence of acetanilide. We stopped at the production of the violet mass, and I cannot say what would have been the effect of heating for "several hours." I have not analysed the plaintiff's blue. The defendant's blue shows in the spectrum a band of green and a band of red, similar to aniline, prussian, and cobalt blue. The bands seemed to be of the same width.

M. Kopp examined (in English) by Mr. Grove: I have followed Girard's specification and produced the result. I employed the time and temperature stated. I have tried the crude nitrate of rosaniline, and it produced the violet and blue. We tried experiments at Lyons with the acetate, arseniate, oxalate, and hydrochlorate of rosaniline, and obtained the violet mass. The violet mass can only

mean the crude mass. In Lyons we made no experiments with the nitrate.

Cross-examined by Mr. Aston: I did not dye with the blue obtained from the nitrate. In treating the violet mass with acid you get the blue. You can purify the blue on cloth or silk with acid water. By passing through acid water it is made more blue. I consider all commercial blues have traces of red. Azaleine was made with nitric acid, and the maker was prosecuted for infringing Girard's patent. Azaleine was crude red aniline dye. In producing aniline blue from aniline red, I always treated with hydrochloric acid; many strengths of acids will do, but a weak acid is best. I have not produced the blue dye in thirty-five minutes. I only experimented to see whether working according to the patent I could produce the dye. I heated the mixture of red aniline dye with aniline for five or six hours. Less time will do with the acetate of rosaniline. I obtained a small quantity of violet and a large quantity of blue. If you go above 180° you may destroy the dye, if you do not take precautions to make the aniline flow back.

Re-examined by Mr. Grove: Nearly all the aniline salts will do. Other acids will answer, but hydrochloric is cheapest. Dyers prefer sulphuric because hydrochloric often contains iron.

Dr. Redwood examined by Mr. Drewry: I took part in the experiments of November 19 and 21, and agree with Dr. Hofmann's description of them.

Cross-examined by Mr. Jessel: With the specification in my hand I should have known what substances to begin with. I should have taken red aniline dyes such as were exhibited in 1862. I did not know them in 1861. I find "purified in the usual manner" in the specification, and by referring to patents existing at the time I know what is meant by that. I cannot say that a heat of 155° to 160° is necessary. In some cases it is necessary to boil longer than in others. We could get violet with either strong or diluted acid, but for blue you must have strong.

Mr. E. C. Nicholson, examined by Mr. Russell: I am one of the plaintiffs. So far as I know, Girard's process was new. I have made the blue without difficulty by following the specification, which is quite intelligible to competent workmen. We have worked the patent since July, 1862, and have paid the proprietors 16,000*l.* for royalties.

Cross-examined by Mr. Jessel: We make the blue substantially by this process. If we used glacial acetic acid I should say it was substantially the same thing. We use 20 lbs. of rosaniline, 60 lbs. of aniline, and 4 pints of glacial acetic acid in our first process, and boil for an hour and a-quarter. We go as high as 300° to 360° F., and sometimes to 370° . When the boiling is blue we add 4 pints of glacial acetic acid dissolved in 20 pints of methylated spirit. We use no hydrochloric acid. That is substantially in accordance with the patent. We take the quantity of rosaniline [the colourless base] and glacial acetic acid in the exact proportion to form red aniline dye instead of making it separately. We then heat it with the aniline, and in the course of an hour and a-half it passes through the violet to the blue stage. We then dissolve it in a mixture of glacial acetic acid and spirit. We have 20 lbs. of rosaniline to 5 lbs. of acetic acid. If I used pure glacial acid there would be 1 lb. over, but commercial glacial acid is never anhydrous. We make three qualities of glacial acid, containing respectively 40 and 20 per cent. of water, and no water. We use a mixture of the two former. The patent says you are to boil for five or six hours; we do not boil so long. "Methylated spirit" is not in the patent. I did not tell Dr. Odling anything of the process he was to use in making the blue dye. The "slight modification" which has been alluded to is the use of acetic acid. This is not in the specification, but "red aniline dye" is. Three red aniline dyes are now known in commerce—the

acetate, the chloride, and the oxalate of rosaniline. I don't think the arseniate is a commercial article now. Chloride contains some arseniate. I do not know that I could get 20 tons of arseniate, and should stop it if I did. The substance mentioned in Medlock's patent is not sold by us as arseniate, but as acetate. I cannot say that the arseniate was sold at the date of Girard's patent. I did not know of the nitrate till yesterday. I took 7 lbs. of acetate of rosaniline and heated it to 300° to 310° F. with one pound and in another case one and a-half pounds of aniline for an hour and a half. I poured the melt into a copper and boiled it with weak hydrochloric acid—a gallon of acid to twenty gallons of water. I boiled it again until it was blue. The strongest acid I used was one gallon of commercial acid to five gallons of water. The acetate of rosaniline was crystallised. Crystallised acetate of rosaniline was known in the market in 1861. Its composition was known to me in February, 1861, but it was not publicly given to the world by Dr. Hofmann until February, 1862.

Re-examined by Mr. Giffard: Nitrate of rosaniline was not a commercial article. Dyers generally use sulphuric acid, but sometimes hydrochloric. With water only the blue dyes would be a dirty grey blue. At the date of the patent the composition of red aniline was not known.

Dr. Odling, examined by Mr. Russell: I know Girard's patent, and have made the blue by strictly following it. [Produced specimens.] I had some instructions about the dyeing, but not in making the dye. I was told to use hot water, and acidify it slightly with sulphuric acid. I have heard Mr. Nicholson describe his process; and, comparing it with the specification, the only difference is in the length of time the mixture was heated. I received a sample of blue dye and analysed it. The mass was blue dye; but there were traces of red dye and hydrochloric acid. I have no doubt the blue was produced according to Girard's process, or a process substantially the same. I also analysed a sample of "Bleu de Lyons," which confirmed my previous conclusion as to the mode of production.

Cross-examined by Mr. Jessel: The blue I made was made according to the patent. Hydrochloric acid is used to remove the purple from the mass. Not using hydrochloric acid does not make a substantially different process. Sulphuric acid I should say was the same. Acetic acid under some circumstances will do. Alcohol would do, but it would be a loss. There is another difference, three of aniline to one of rosaniline, instead of equal weights. I should not say that any proportions would do. Have only used myself the proportions in the patent. There is a difference in the time of heating. I heated for an hour and a-half, and also for five hours. Following the patent, you would heat for more than an hour and a-half, and I think I made the best blue with the five hours' heating. I used something labelled "Magenta Powder;" it was acetate of rosaniline. I purified the aniline myself; it probably contained toluidine. I used equal weights, according to the patent. I got the blue before boiling with hydrochloric acid. I got violet after heating an hour and a-half. After five hours' heating the mass was blue, but it was still possible to get violet from it. I have experimented with sulphate, chloride, and arseniate of rosaniline, and got violet from each in five hours. The salts were supplied by Mr. Nicholson. I tested them for acetic acid and acetanilide; and the test used would have shown benzoic and most other organic acids. It would have revealed oxalic acid. I have made lots of acetanilide. I say I found hydrochloric acid because I found chlorine. If chloride of rosaniline and acetic acid had been used, I should find chlorine. Chloride of rosaniline and acetic acid will give you an acid solution. I should say it would give both my results. I do not know whether it would contain chlorine, but my impression is that the chlorine would combine with the blue and give

chloride of blue. You would get chlorine from salt and water. I should say that hydrochloric acid had been used; but mine was not a positive test. I found a small quantity of red dye. I used an alkali of ordinary strength to detect it. There is a carbolic acid red dye; alkalis do not alter it. Red aniline dye is always altered by alkalis. I used ammonia of the ordinary strength. I have read Gilbee's specification. [Extract read.]

"The invention consists in the manufacture of an improved blue colour, which I call rosaniline blue, and in the process or means to be employed therefor, and is based on the discovery made by Professor Hofmann, of London, that rosaniline was a colouring basic substance, susceptible of producing colouring matters in the greater parts of its combinations. I obtain rosaniline on a commercial scale of a white, rosy, or greyish colour, by treating the salts of its base (which salts are known in commerce by the name of red aniline) in a hot aqueous solution, saturated with caustic alkali, either soda, potash, or ammonia, in the proportion of two parts of alkali to one part of rosaniline salt employed. The mixture is kept in ebullition until the rosaniline in suspension in the liquid no longer loses its colour. I prepare an acetate of aniline by mixing 100 parts of aniline with acetic acid of commerce (40 per cent. crystallisable 20 parts). One part of rosaniline is mixed with 5 parts of this acetate, the whole is heated and kept slightly boiling until the whole mass becomes of a blue colour. To obtain a blue colour with a purple or red tint, the vessel containing the mixture should be removed from the fire directly the desired tint is obtained. The raw blue obtained is poured into a highly diluted solution of sulphuric acid, which must contain a sufficient quantity of acid to saturate the aniline employed in the production of the acetate. I filter the solution to separate the blue formed, then boil it with water several times until the latter is colourless. In cooling the blue separates in the form of a resinous mass, which after being reduced to powder is dissolved in six to eight times its weight of concentrated sulphuric acid: it is then precipitated in a large quantity of water. By drying this precipitate the blue is obtained in the form of a copper coloured powder."

I have never tried that, but I should think it would give a good blue. The process is almost identical with what I have tried, if you put hydrochloric for sulphuric acid. I know Schlumberger's process [Patent No. 117, of 1863]. No doubt it will give a blue. Acetic acid or sulphuric would do for Girard's process; he points out the cheapest or the cheapest but one. I made no experiments with a nitrate of rosaniline.

Re-examined by Mr. Grove: I think my deduction that hydrochloric acid was used in making the blue was correct, because the chloride of blue would be insoluble. This was the first blue known. There is a blue called carbolic acid blue, but it is a questionable substance. Grignon's blue came after. Chinoline blue is very different, and came earlier. Rosolic acid is red.

Mr. Warrington, F.R.S., examined by Mr. Grove. Had analysed samples of blue dyes received from the plaintiffs. Found them to contain traces of red aniline dye, aniline, and hydrochloric acid. Believes them to have been made by Girard's process, or a process substantially the same.

Cross-examined by Mr. Jessel: Sulphuric acid was the chemical equivalent of hydrochloric acid, if it were used to produce an equivalent result. Its use was an evasion if used to obtain the same result. One salt of aniline used for another was an evasion. It was the same with acids used with salts. Whether you made the salts or used salts ready made was the same. [The Vice-Chancellor here remarked that the Lords had decided that the opinion of a scientific witness as to an evasion could not be received.] Made only a qualitative analysis of the dyes. Found hydrochloric acid, but could not say how much chlorine was present. The chlorine might have come from the

hydrochlorate of rosaniline. Had made the blue dye from the chloride; it was insoluble in dilute acid, but soluble in alcohol and acetic acid. The red dye could not have been made from carbolic acid or carbolic acid and aniline. Never saw rosolate of aniline. Did not know whether rosolic acid and aniline would make a dye. Rosolic acid was made from carbolic acid; should have found it in the analysis if it had been present. Only found the three bodies tested for. No acetic acid was present. Sulphuric acid would have detected it. Had made experiments with Girard's process, and always succeeded in forming the blue. Used a number of red aniline dyes—five in the experiments—but no nitrate. Used the acetate and then obtained the violet mass in one hour.

Re-examined by Mr. Grove: The heating finished when the violet was obtained. No red was left if the purification was complete. The chloride of the blue was insoluble in water. The treatment with hydrochloric acid removed the red dye and aniline which had escaped transformation.

A clerk of Messrs. Simpson and Co., and a man who had formerly travelled for the defendants, were now called to identify and prove the delivery of the samples to Mr. Warrington.

Mr. J. W. Speed, examined by Mr. Russell: I am now a dyer at Manchester. Was at Milan with the defendant. Knew Michel and Burdet there, who came from Girard's. They made blue dye at Milan with magenta crystals, aniline, and benzoic acid. They used benzoic acid in the proportion of one-eighth the weight of the aniline.

Cross-examined: Knew Girard's patent. Could only make a blue violet with a tinge of red by the process described in it. Used red aniline dye and aniline, and heated for three hours and a half. Did the best he could, but could only get a blue violet, a purplish blue. Knows the defendant's process, which makes a true blue. Meant the blue made by the process described as the defendant's, but made with magenta crystals, aniline, and benzoic acid, but no other acid.

Re-examined by Mr. Grove: Used hydrochloric acid afterwards and ordinary spirit of wine. Red aniline, rectified aniline, and benzoic acid give a blue when hydrochloric acid and alcohol are used afterwards. He first obtained a dirty blue purple. The melt was procured in half an hour.

By the Vice-Chancellor: The melt, when pressed and dry, was bronze coloured. Spirit gave a blue solution with it.

This closed the case for the plaintiffs.

Mr. Jessel then addressed the Vice-Chancellor on the part of the defendants, contending, first, that Girard's patent was bad on several grounds; and secondly, that the defendant's dye was produced by a substantially different process.

Trinity College, Dublin.—Degree conferred by the Earl of Rosse, Chancellor. Doctor of Medicine, *Honoris Causâ*: Maxwell Simpson.

Royal Institution.—Tuesday, Thursday, and Saturday, December 27, 29, 31, at 3 o'clock, Professor Frankland "On the Chemistry of a Coal" (juvenile lectures).

ANSWERS TO CORRESPONDENTS.

Dr. Bond.—Mr. Solomon, Red Lion Square.

H. R. C.—The solution generally used for crystallising on glass is a moderately strong one of sulphate of magnesia, thickened with a little gum arabic. Kuhlmann has lately said that sulphate of zinc used in the same way answers the purpose. You may colour the solutions if you please, and obtain very pretty effects. (2.) Reduce with sulphurous acid, and separate by crystallisation.

Book Received.—The Philosophy of Health, by Southwood Smith M.D.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analyses of Sewage, by Dr. T. L. PHIPSON, F.C.S., &c.

DURING the last twelve months several samples of sewage have been forwarded to me for analysis, and I have been kindly permitted to publish some of the results obtained. I subjoin a partial analysis of stable manure as a sort of comparison:—

I. Entire Sewage.

	Stable Manure.	House Sewage.	House and Stable Sewage Combined.	Common London Sewage.
Water . . .	70.000	98.700	94.400	99.975
Dry residue .	30.000	1.300	5.600	0.025
	100.000	100.000	100.000	100.000
Nitrogen . .	0.500	0.117	0.370	...
Or, ammonia	0.607	0.128	0.450	...

No. 1 was an ordinary sample of stable manure; No. 2 was the sewage of a large establishment; it was conveyed into tanks, constructed purposely, instead of into the river; No. 3 was the product of another tank which received both the house and the stable sewage; No. 4 was sent to me with a label "Thames Sewage," but I do not know where it was taken.

II. Sewage Evaporated to a Portable State—Analyses of the Dry Product thus Obtained.

	London.			Wolverhampton.			Edinburgh (obtained by precipitation).
Water . . .	2.50	12.00	18.00	2.80	3.00	9.00	17.00
Organic matter .	71.30	59.50	56.60	70.00	66.00	63.00	20.50
Phosphate of ammonia .	1.25	1.87	..	2.10	2.00	..	..
Phosphate of lime and magnesia*	5.00	9.50	10.00	6.50	11.40	..	8.00
Sulphate of lime .	1.50	2.00	..	1.60	2.00	28.00	7.00
Alkaline chlorides and sulphates .	7.95	7.13	7.40	7.00	6.60	..	3.50
Sand . . .	10.50	8.00	8.00	10.00	9.00	..	40.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00†
Nitrogen . . .	6.24	6.00	3.43†	6.16	7.56	7.21	1.65
Or, ammonia . .	7.58	7.30	4.17	7.48	9.18	8.77	2.00

III. Sewage of Carlisle Solidified by Peat Charcoal.

Water . . .	54.75	50.00	38.00	39.00	26.00	51.58
Organic matter .	22.25	23.00	20.40	19.50	22.80	20.76
Phosphate of lime and magnesia .	1.25	..	..	1.50§	7.80	..
Carbon and silica .	21.50	27.00	41.60	40.00	33.50	27.66
Alkaline salts . .	0.25	..	..	..	8.70||	..
	100.00	100.00	100.00	100.00	100.00¶	100.00
Nitrogen . . .	1.65	1.48	..	2.60	2.67	2.20
Or, ammonia . .	2.00	1.80	..	3.15	3.25	2.60

I should state that none of the above had been subjected to an admixture of impurities from manufactories, &c., and it would, on that account, be interesting to compare these results with the analysis of a fair sample of average London sewage, as it finds its way to the river. I have not yet had an opportunity of analysing the latter.

London, December, 1864.

* Including sometimes about 2.5 of phosphate of iron.

† Add, carbonate of lime, 4.00 per cent.

‡ It is evident here that carbonate of ammonia has been volatilised during the evaporation; hence the necessity of fixing this salt according to Mr. Manning's plan.

§ Including oxide of iron and alumina 0.65.

|| Including sulphate and carbonate of lime.

¶ Add, oxide of iron, 1.20.

VOL. X. No. 265.—DECEMBER 31, 1864.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 15, 1864.

R. ANGUS SMITH, Ph.D., F.R.S., &c., President, in the
Chair.

THE following letter from Mr. James Nasmyth, C.E. addressed to Mr. Joseph Sidebotham, and dated November 8, was read:—

"I had intended to have sent the Manchester Literary and Philosophical Society 'a Paper,' embodying some ideas I entertain in regard to the vast antiquity of the features and details of the lunar surface, but in attempting to put my views on this subject into the formal shape of 'a Paper,' somehow or other my pen won't say what I want it to express, so I am fain to get out of the difficulty by sending you an abstract of my views on this subject in the form of a letter. The views I entertain on the subject in question are these—namely, that as a direct consequence of the small mass of the moon, and its comparatively large surface, it must have parted with its original cosmical heat with much greater rapidity than in the case of the earth, and consequently the moon must have assumed a final condition of surface structure ages before the earth had ceased from its original molten condition. And as the moon had in all reasonable probability never possessed an atmosphere or water envelope (it certainly has none such now), while the earth has both, the action of the earth's atmosphere, and especially that of its ocean when it existed in the first instance as a vast vapour envelope, ere the earth had cooled down so as to permit the ocean taking up its final position as an ocean, this mighty vapour envelope must have retarded the escape into space of the cosmical heat of the earth millions of ages after the moon had assumed its final condition as to temperature. Therefore it is from such considerations I am led to the conclusion that the surface features and details of the moon present to us a sight of objects, the antiquity of which is so vast as to be utterly beyond the power of language to express; and scarcely less so for the mind to conceive. But yet at the same time such considerations appear to me to enhance so vastly the deep interest which ever attends the examination and contemplation of the moon's wonderful surface, that I would earnestly urge those who agree with the soundness of these views to bear them in mind next time they have an opportunity to behold the marvellous details of the lunar surface, as I am fain to think that in doing so the interest of what is there revealed to them will be rendered vastly more impressive."

The PRESIDENT read a paper "On the Composition of the Atmosphere." He believed that his inquiry proved that the oxygen test was a very valuable one, as indicating the condition of the atmosphere. The oxygen was diminished in many cases, and, indeed, in all cases where the air was known to be inferior. He said the objection to such air may perhaps be found not so much in the absence of oxygen as in the gases which take its place. That place was not wholly supplied by carbonic acid. He believed it needful to examine the composition to the second decimal place in the case of oxygen, and to the third or even fourth in the case of carbonic acid, as extremely small amounts of some gases affect us. Hitherto we have had the composition of the air given in numbers varying a tenth per cent.—specimens have generally been taken from rooms on streets or open places indiscriminately. It is the author's wish to show that variations are dependent on the conditions of soil, situation, wind, &c., and that the oxygen and carbonic acid together may with very minute analysis guide us in our sanitary inquiries. The paper cannot easily be given in abstract, further than by adding a table

of the analyses showing the average numbers obtained in various places:—

Analyses of Atmospheres varying in Oxygen.

	Oxygen per cent.
	Avg. Nos.
N. E. sea-shore and open heath (Scotland)	20.999
Tops of hills (Scotland)	20.98
In a suburb of Manchester in wet weather	20.98
Ditto ditto ditto	20.96
Front of street $\frac{3}{4}$ ths of mile from Exchange, Manchester	20.945
At the back part of the house	20.936
Low parts of Perth	20.935
Swampy places (favourable weather)	20.922 to 20.95
In fog and frost in Manchester	20.91
In sitting-room which felt close, but not excessively so	20.89
In a small room with petroleum lamp, well ventilated	20.84
Ditto after six hours	20.83
Pit of theatre, 11.30 p.m.	20.74
Gallery, 10.30 p.m.	20.36
In large cavities in mines	20.77
In currents	20.65
Under shafts	20.424
In sumps	20.14
When candles go out about	18.5
The worst specimen yet examined in the mine	18.27
Very difficult to remain in for many minutes	17.2

Analyses of Atmospheres varying in Carbonic Acid.

	Avg. of carbonic acid per cent.
Manchester streets, usual	0.0403
During fogs	0.0679
About middens	0.0774
Average	0.0442
Fogs excepted	0.0424
Fogs and middens excepted	0.0403
Where the fields begin	0.0369
In close buildings	0.1604
Minimum of suburbs	0.0291
Over North Scotland (towns excepted)	0.0336
Candle goes out 1.8 to	2.5000
Lowest found in mines	2.5000
Lowest entered	4.0000

The greater part of this is given in Dr. Angus Smith's report "*On the Air of Mines*"—Appendix to Report of the Royal Mines Commission, 1864.

MICROSCOPICAL SECTION.

First Ordinary Meeting, Session 1864-5.

October 17, 1864.

JOSEPH SIDEBOTHAM, Esq., President of the Section, in the Chair.

The PRESIDENT stated that he regretted to have to inform the members of the total failure of the efforts made during the last summer to provide them with fresh cotton pods for the purpose of investigating into the structure of the cotton fibre. This was partly owing to ravages of the common greenhouse pest, the red spider, and partly unaccounted for, as the plants had flowered but not fruited. He called the attention of the meeting to the compact form of microscope made by Mr. Dancer to facilitate sea-side and other investigations, where portability, combined with means of using the higher powers, was the chief desideratum. A specimen was on the table, and he and other members could bear testimony to its advantages. He also called the attention of the members to the many beautiful forms of insects and vegetable life which were frequently neglected as being too small to be examined by the unaided eye, and yet too large for the ordinary powers of the microscope. He assured the members the use of

the present three or two-inch object-glasses would reveal to them many objects of surpassing beauty, which had hitherto only been studied in detail. With regard to the use of such powers as the $\frac{1}{16}$ th or $\frac{1}{25}$ th, he thought they seemed to have reached the limits of the available power of microscopic object-glasses, as it appears impossible to separate or define lines more numerous than ninety thousand in an inch, on account either of the decomposition of light or some other cause. It therefore seems beyond our power ever to discover more of the ultimate composition of matter by aid of the microscope, even were we not prevented by the material composition of our lenses and organs of vision. We have, however, penetrated to the very confines of organic life, if not beyond, inasmuch as no organisms appear to exist smaller than those we can already see. It is, moreover, a curious fact that the smaller creatures are composed of fewer elements than the larger ones, and that the number of elementary bodies composing them decrease in number as the organisms themselves decrease in size. It becomes, therefore, a matter for speculation whether the reason of this may not be that the ultimate atoms of some elementary bodies are larger than others, and that these, from their size, cannot be used in the composition of the more minute forms of organic bodies, and that smaller organisms than those about $\frac{1}{75000}$ th of an inch do not exist, because the ultimate atoms of all solid bodies are too large to be economically used in their formation. The telescope appeared to have infinite fields of distance to explore, but it would seem the microscope had nearly reached the limits of its possible power.

Mr. J. B. DANCER, F.R.A.S., then read a paper "*On a Contrivance for Regulating the Amount of Light Transmitted from the Source of Illumination to the Mirror of the Microscope.*" When viewing certain objects by transmitted light, and particularly with oblique illumination, a very slight alteration in the quantity and direction of the light produces a marked difference in the appearance of the object, especially in Diatomaceæ, where a proper management of the light shows lines or markings invisible under ordinary direct illumination. The apparatus now exhibited is one easily made at a trifling cost, and consists of a circular disc of blackened tin or cardboard ten or twelve inches in diameter, with a number of perforations of various shapes and sizes—circular, cross-shaped, wedge-shaped, &c.—the centres of which are about $3\frac{1}{4}$ inches from the centre on which the disc, placed perpendicularly, rotates. The form of perforations found generally most useful are parallel slits—slits at right angles to each other—wedge-shaped and circular openings. The object under view must be well illuminated in the direction required, and then the disc, supported by a pillar, is placed between the source of light and the concave mirror, when a few trials will determine the best form of aperture. The markings of Pleurosigma fasciola, angulatum, &c., may be seen by its aid under powers which would not show them with any arrangement of achromatic condensers, and it also has the good property of shading all but the amount of light required from the lower portion of the microscopic stage and stand. The disc might be attached to the lamp, but it appears to work better on a stand, and is susceptible of various modifications which will readily suggest themselves to the microscopist.

Mr. W. H. HEYS exhibited specimens of leaves of the vegetable marrow, showing reticulated markings somewhat similar to those of Symphytum, and presented a slide to the cabinet.

Mr. SIDEBOTHAM stated that in sweeping over herbage for Coleoptera and other insects, he had found some very curious seeds, to one of which, that of Sanicula Europea, he thought attention had not hitherto been drawn, though well deserving of it. Those of Henbane and Daucus were also most singular.

Mr. LINTON exhibited the elegant tufted stigmas of

Poterium sanguisorba, and the very singular calyx of the gum cistus, which might almost be mistaken for the skin and scales of a fish.

Ordinary Meeting, November 29, 1864.

R. ANGUS SMITH, *Ph.D., F.R.S., &c., President, in the Chair.*

Mr. E. C. Buxton was elected an ordinary member of the Society.

Dr. JOULE exhibited a magnetic needle for showing rapid and minute alterations of declination. It consisted of a piece of hardened and polished watch spring, an inch long and one-tenth of an inch broad, suspended vertically by a filament of silk. The steel was magnetised in the direction of its breadth. He remarked that Professor Thomson had long insisted upon the advantages which would attend the use of very small bars in most magnetical investigations, and had employed excessively minute needles in his galvanometers with great success. Dr. Joule stated his intention to fit up his needle so as to be observed by light reflected from its polished surface, or otherwise by viewing a glass pointer, attached to the bottom of the steel, through a microscope. He believed that by the latter plan he should be able to observe deflections as small as 1" of arc.

ACADEMY OF SCIENCES.

December 19.

A MEMOIR by M. Houzeau, entitled, "*Study of Arseniferous Hydrochloric Acid*," was read. The author gave the amounts of arsenic he had found in various specimens of the acid, states that the arsenic exists in the acid in the state of chloride, and, lastly, gives a method of purifying the arseniferous acid. This last section of the memoir we shall translate.

M. Margueritte replied to M. Caron in another note "*On the Cementation of Iron by Carbonic Oxide and Carbon*." The dispute between these gentlemen seems endless.

Mr. Terreil presented "*Analyses of some Minerals from Siam*." These consisted of two gold ores, an Oriental emerald, some iron ores, and a bituminous matter containing sulphur.

M. Gal presented a note "*On a New General Property of Ethers*." The author finds that ethers treated with hydrobromic acid split up, forming hydrobromic ether, and setting the acid radical free.

M. Batka gave a new "*Analysis of the Follicles of Senna*," for which we have no space to-day.

NOTICES OF PATENTS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2920. G. M. de Bayelt and J. Vigouléte, "An improved method of compounding by agglomeration artificial fuel."—November 23, 1864.

2998. C. Binks, "Improvements in separating sulphur from coal and coke."—December 1, 1864.

3017. J. G. Ulrich, "Improvements in the means and contrivances employed in the packing, conveying, and storing of gunpowder and other explosive materials, to prevent the accidental explosion thereof."

3018. C. W. Siemens, "Improvements in apparatus for the production, purification, and combustion of gases for heating purposes."—December 3, 1864.

3020. J. G. Winter, "Improvements in revolving retorts, and in the mode of applying heat to the same, designed

for producing oil from coals, shales, cannels, and other substances, or for distilling oils."—December 5, 1864.

3071. J. Vaughan, "Improvements in heating the blast for furnaces in the manufacture of iron."—December 10, 1864.

3095. J. B. Thompson, "Improvements in coating iron and steel with silver, gold, platinum, or palladium, and in ornamenting articles with such metals."

3101. P. F. Lundc, "Improved apparatus for obtaining extracts from vegetable substances."—December 14, 1864.

Notices to Proceed.

1998. H. Armistead, "Improvements in dyeing and sizing, or preparing warps for weaving."—August 10, 1864.

2003. J. A. and J. Webb, and J. J. Monteiro, "Improvements in the application and in the preparation of certain fibres for the production of paper and textile fabrics."—August 11, 1864.

2026. R. T. Monteith, "Improvements in preserving eggs."—August 13, 1864.

2043. P. A. le Comte de Fontainemoreau, "Certain improvements in the process of preserving animal and vegetable alimentary substances."—A communication from François Xavier Escofet.—August 17, 1864.

2359. L. A. and W. Bryer Nation, "A mode of separating the pitch and spirituous oils from all matters containing them."—September 26, 1864.

CORRESPONDENCE.

The New Aspirator.

To the Editor of the CHEMICAL NEWS.

SIR,—Professor Clifton informs me that the swivel aspirator described as invented by Mr. Dancer, of Manchester, was, in reality, first described by M. Boisgiraud. I am sure Mr. Dancer was not aware of this, and I still feel obliged to him for his device, although, of course, we must keep to the rule carefully to give the first inventor the chief credit. The instrument had gone through two stages previously, in the aspirators of Boswell Reid and Brunner.

I am, &c.

R. ANGUS SMITH.

Manchester, December 10, 1864.

Assay of Tin Ores.

To the Editor of the CHEMICAL NEWS.

SIR,—Agreeably to your request I now send you the particulars of the method of estimating the value of tin-stone by dry assay, which has been frequently practised by myself during the last nine years, and has uniformly furnished correct results with but little expenditure of time and labour. The flux employed is cyanide of potassium, and the method of operating has been usually as follows:—The sample having been carefully selected is first crushed by the hammer in a steel mortar, and then further reduced to powder in an agate mortar. 100 grains is a convenient quantity to be taken for analysis, and it is always advisable to make two independent experiments upon the same sample of ore, with the view of having a control, and the highest result obtained is that upon which I place reliance, since the error must always be on the side of loss rather than excess. A couple of small Hessian crucibles, of about 3 oz. capacity, are prepared in the first instance by ramming into the bottom of them a small charge of powdered cyanide of potassium sufficient to form a layer of about half an inch in depth; the weighed quantities of tin ore are then intimately mixed with from four to five times their weight of the powdered cyanide, and the mortar rinsed with a small quantity of the pure flux, which is laid upon the top of the mixture. The crucibles are then heated in a moderate fire, or over a gas-blowpipe, and kept for the space of ten minutes at a steady fusion;

they are then removed, gently tapped to facilitate the formation of a single button, and allowed to cool. Upon breaking the crucibles the reduced metal should present an almost silvery lustre, with a clean upper layer of melted flux. I have usually taken the precaution of dissolving the latter in water for the purpose of satisfying myself in regard to the absence of any trace of reduced metal or heavy particles of the original ore. There is always contained in the commercial cyanide a sufficient quantity of alkaline carbonate to secure the perfect fusion of the silicious gangue and other like impurities in the tin ore, but the operator should assure himself of the absence of copper and lead in the ore, either by preliminary treatment with hydrochloric acid, in which tin-stone is absolute insoluble, or by testing the button of reduced tin after hammering or rolling for such metallic admixture. I have usually found a minute trace of iron, and sometimes gold in the melted buttons, but not so much as to add appreciably to their weight.

My experiments have sometimes furnished identical results, but I would rather state of this process that when worked with ordinary care it may be relied upon as giving numbers true to within $\frac{1}{2}$ per cent., and I do not know any other method which exceeds this in accuracy and rapidity of execution. I append a few analytical results taken at random from a number of ores assayed in this manner:—

	Tin per cent.	
	I.	II.
Sample No. 1 . . .	45.6	45.8
„ No. 2 . . .	57.2	57.6
„ No. 3 . . .	68.4	68.7
I am, &c. METALLURGIST.		

December 15.

MISCELLANEOUS.

RENARD v. LEVINSTEIN.*

Before Vice-Chancellor Sir W. P. Wood.

(Continued from page 312.)

IN the course of Mr. Jessel's speech for the defendant, a question arose upon Girard's patent of 1860. This was for the production of colouring matter simply, not for dyes specially, but an allusion to a blue colour was looked upon as a prior publication of the process of 1861. Some of the plaintiff's witnesses were therefore recalled to prove that the two patents were for substantially different matters. We need not further allude to this part of the proceeding, as it only formed an episode in the trial, but proceed now with the evidence for the defendants.

The first witness called was Professor J. A. Wanklyn, who was examined by Mr. Aston. He said he had considerable experience in the mode of making aniline blue, having manufactured and sold it in Heidelberg in 1862-3. He made the blue in two ways. In one he used the red aniline dye commonly known in Germany; this was the arseniate of rosaniline, and was moist with hygroscopic water. To this he added aniline, and heated. While the mixture was hot he added benzoic acid, and continued the heat for a time until a bronze mass was formed, which was semi-fluid while hot, and solid when cold. He took from time to time a portion out of the vessel, and dissolved it in alcohol, and as soon as the solution was blue the process was finished and the dye was perfect. In general he heated to 170° C., but the temperature might at times be higher, and at times lower. After the benzoic acid was added the process soon came to a close, generally in an hour. The proportions he used were one part of arseniate of rosaniline, one and a-half parts of aniline, but the proportion of aniline was not material, and of

benzoic acid one-fourth the weight of the arseniate of rosaniline. These proportions produced a really good blue after purification. He purified with ether, which removed the unchanged aniline and the tarry matters formed; after that the dye was ready for the market. He purified in another way, by treating the melt with alcohol and then with diluted hydrochloric acid; the dye was then washed, separated by filtration, and dried. Or he washed the melt (bronze mass) with acetic acid, and used ether when much tar was present. It was immaterial which method of purification was used. He made many experiments to obtain blue. If the arseniate of rosaniline was replaced by the acetate, an equally good colour was produced. Arseniate of rosaniline, aniline, and acetate of soda also made a good colour. The result was the same with acetic as with benzoic acid, but without either benzoic or acetic acid no bronze-coloured mass was obtained. Benzoate of aniline decomposes at 150° C.; most of the aniline salts part with aniline at 150° C. He knew Girard's specification. Had tried the process in Germany because he wanted to dispense with benzoic acid. With Girard's process very little change took place. He never got blue without benzoic or acetic acid. Had made experiments with Girard's patent in conjunction with Dr. Miller, but did not remain until the experiments were completed. Knew the tests for acetic acid and acetanilide, but had never seen acetanilide. Sulphuric acid would detect acetic acid; small quantities would be detected by the kakodyle test.

Cross-examined by Mr. Grove: Small quantities of acetanilide could not be detected. Has taken out two patents, one of which is completed. Patented the use of benzoic acid in November or December, 1862. Had experimented and manufactured perhaps two or three cwt. of the colour in Germany. A manufactory was started in London in 1863, and is still going on. The defendant, Levinstein, works under a license from me. I do not assist in the manufacture; have made the colour to show people. I have a patent for making purple dyes from manna sugar. Have never seen the operation at work. Have never seen aniline used in the process, but rosaniline in some form or other is used. I don't know the proportions of manna sugar used. Cannot tell the chemical reason why benzoic acid produces the colour quicker, and in operation. Can only say the process goes better. Have patented a purple dye called "Avelia." It is an organic dye.

Re-examined by Mr. Jessel: You cannot get a blue by Girard's process with an inorganic acid and without an organic acid in some form or other either in a salt or free. With an organic acid you get the blue at one operation. The red gradually becomes blue.

Mr. D. Campbell, examined by Mr. Jessel: Is familiar with several aniline dyes, and knows Girard's patent of 1861. Tried experiments with it in 1861 or '62. Obtained a good violet by the first part of the process, but not a true blue by the second. All his experiments with the second part were failures; got only a dirty greyish blue with the chloride; with the arseniate got better. Followed the directions of the specification carefully, and did his best to get the colour. Tried solid and liquid red aniline dyes; tried all the red aniline dyes he knew. The first experiments were made for his own information. First heard of acetate of rosaniline at the Exhibition of 1862. Has heard of the oxalate recently, but is not aware that it is sold now. In 1861 only the arseniate and chloride of rosaniline were sold as red aniline dyes. Made experiments for the defendant with Girard's patent in April, 1864. Got no better results than in his former experiments. Tried acetic acid afterwards, and soon obtained the violet, and afterwards the blue. The violet was obtained immediately, and the blue in about an hour. Had never tried the oxalate. Used equal parts of aniline and acetate of rosaniline; heated them from 320° to 350° F. for an hour.

* Our report is necessarily confined to the scientific part of the evidence. Of the personal matters in dispute we shall take no account.

Bought red aniline dye of Judson and Sons; got a solution of chloride of rosaniline and used it. Did not get a good colour. Tested the solution, and found no acetic acid, so assumed it was chloride. When benzoic acid was added to the chloride of rosaniline and aniline after they had been heated for some time, you get a blue directly, or in an hour. With arseniate of rosaniline you get the same result, when benzoic acid is used. The result has some red in it, and the blue is not pure, but it is good. Two ounces of arseniate of rosaniline, three ounces of aniline, and a half-an-ounce of acetate of soda heated for three-quarters of an hour gave a blue mass on the addition of twenty-five grains of benzoic acid. The same proportions of the other ingredients, but without the benzoic acid, gave a blue, but not so good. In purifying these, he only heated once for a quarter of an hour with hydrochloric acid. This was to remove the excess of red and aniline. Sulphuric acid would do the same, but hydrochloric is the best. The first part of Girard's patent, using solid acetate of rosaniline, and heating for an hour, gives a blue at once, without any violet stage. Had always bad results with solutions of salts of rosaniline. Tried rosaniline with three times its weight of aniline, and with glacial acetic acid; heated them together up to 330° — 370° F. for seventy minutes, and obtained a good blue. The red aniline dyes at the date of the patent were the arseniate and that made with nitrate of mercury. Red aniline dye was always an inorganic salt, unless afterwards converted into an organic. No good dye could be obtained by Girard's specification.

Cross-examined by Mr. Grove: Had made no experiments with the patent of 1860. In experiments with the patent of 1861 used the exact proportions mentioned in the specification. Only knew the chloride and arseniate at the time. The chemical composition of the dyes was not known at the time. Used pure crystals of salt of rosaniline, and dissolved them to see if the solution would answer. Dissolved half an ounce of crystals in ten ounces of water. Obtained the acetate of rosaniline he experimented with from Dr. Miller.

Mr. Crookes, examined by Mr. Aston: Was well acquainted with the subjects of light and colour, and was an early experimenter with the spectroscope. Had subjected colours produced by Girard's specification to spectrum analysis. They were either purple or violet, but not blue. Had applied to a chemist for what was known as red aniline dye at the date of the patent, and had been furnished with a moist red mass. It was a very impure material, and contained mercury. Treated the powder with spirit, evaporated the solution obtained, and used the residue for red aniline dye, "purified in the usual manner." Used half an ounce of this residue and half an ounce of commercial aniline. Did not test the aniline. Mixed the materials in a flask, and heated to 165° C., or as near as possible, for five and a half hours. The result was a solid mass of a bronze colour; boiled this with water and hydrochloric acid—one part of acid to 100 parts of water: obtained a red solution which was thrown away. A residue was left which would dye a violet. Treated this for blue by boiling with hydrochloric acid diluted with ten parts of water; boiled it two or three times. A very small residue was left—not $\frac{1}{20}$ th of the ingredients. Dissolved this in spirit: it was more blue than the original violet, but not a pure blue. Examined that solution and others with the spectroscope. Obtained specimens made by Girard's process, and specimens made by the defendant's process, from Dr. Miller. In solution (1 in 250) the blue made by Girard's process was opaque to the orange-yellow and most of the green rays, but transparent to the red and blue. A solution of the same strength of the defendant's blue was quite opaque to red. The defendant's was a pure aniline blue; Girard's appeared to be a mixture of aniline red and aniline blue. The spectrum experiments

showed a decided difference between the defendant's blue and Girard's.

Cross-examined by Mr. Grove: The solution (produced) was made with spirit and water. It was a perfect solution, although it might contain some flocculi. Matter in solution and suspension might, in a few exceptional cases, give different effects in the spectroscope. The violet was a mixture of red and blue, and would necessarily be made more blue by getting rid of the red.

Dr. Letheby, examined by Mr. Bagshawe: [The commencement of Dr. Letheby's evidence was not heard by our reporter.] He had tried Girard's process, and heated the mixture for three or four hours. The result was a dirty violet mass. Indications of decomposition were observed at the expiration of the time stated; so the operation was stopped. Treated the violet mass with very dilute hydrochloric acid. Made a comparative experiment with crude magenta red, and obtained a similar result, but not so bright as in the former case. Treated the mass with stronger hydrochloric acid for the blue; used a solution containing 10 per cent. of commercial hydrochloric acid. Obtained a dirty blue mass which would only dye a dirty blue. Made other experiments with the same proportions of purified magenta and aniline, and one-third the weight of acetate of potash, and also acetate of soda. Heated these mixtures to 165° C. for one hour. With acetate of potash obtained a rich blue at once, which required no further treatment. When acetate of potash is used, believed that the chemical changes which take place are essentially different to what takes place in Girard's process. Benzoic acid acted like acetic in expediting the change. Made no quantitative experiments, but believed that the blue amounted to about one-eighth of the ingredients.

Cross-examined by Mr. Grove: Was not an experienced dyer. In the experiment, which lasted an hour and a-half, obtained a reddish violet mass. The decomposition was shown by the mass turning brown, which showed that there was an end of the profitable change. Did not know the nature of the decomposition. When acetate of potash was used there was a copious evolution of ammonia, but without acetate of potash little or no ammonia was evolved. In the one case the blue obtained is not pure, in the other it is. In following precisely the instructions of the patent there is a great waste of aniline and red aniline dye, and the manufacture would not be profitable.

Re-examined by Mr. Bagshawe: The blue with acetate of potash was obtained without washing; no purification was required. All the material was converted. Could not say whether the products were essentially different or not.

Dr. Miller, examined by Mr. Jessel: Had experimented with Girard's patent of 1861. Used equal weights of arseniate of rosaniline and commercial aniline, and heated the mixture to 160° C. (320° F.) for six hours. Obtained a deep violet mass with a bronze lustre. Boiled the mass with dilute hydrochloric acid, and afterwards with one of hydrochloric acid to ten of water. Did not obtain a blue. Boiled afterwards repeatedly with one of hydrochloric acid to twenty of water until the liquor was colourless. Dissolved the residue in methylated spirit; the solution was purple. The best results obtained by Girard's process was not a good blue. [Specimen produced, which Mr. Grove pronounced to be a good blue.] Had not dyed with the solution. Showed specimens of blue produced with acetic acid; these were much superior. By Girard's process only a small proportion of blue was obtained. In the acetic acid process the whole mass was converted. Had made experiments under directions from the defendant. Heated half an ounce of arseniate of rosaniline, half an ounce of acetate of soda, and an ounce and a-half of aniline to 320° — 330° F. from fifty-five minutes to an hour and a-quarter. In both experiments a blue mass with a coppery lustre was obtained. It was purified by boiling with strong hydrochloric acid; and a good blue was procured at once. Tried chloride of rosaniline accord-

ing to the patent, and got an inferior result. Used various proportions of hydrochloric acid to obtain the best result. Tried nitrate of rosaniline; it answered better than the chloride, but not so well as the arseniate. In one experiment, used half an ounce of arseniate of rosaniline, an ounce and a-half of aniline, half an ounce of acetate of soda, and four grains of benzoic acid. Heated to 310° — 340° . In fifty-five minutes the whole mass formed a good blue melt. Treated this with hydrochloric acid, and pressed, and so obtained a bronze mass. Boiled this with water, and washed with fresh hydrochloric acid, until the washings were colourless. The residue gave a beautiful bright blue dye. In another experiment, heated the same mixture to a lower temperature, but for a longer time, and did not obtain so good a result, although the dye was good. Had made an experiment with one of acetic acid, four of rosaniline (the pure base), and twelve of aniline; heated them to 350° — 370° ; and in seven minutes obtained a blue. There were several points of difference between the process with acetate of soda and benzoic acid and the patented process. In the first case, the melt was blue, and not violet; the blue was obtained in an hour or less, instead of six hours; no purification with strong hydrochloric acid was necessary. The organic salts of rosaniline were not known at the date of the patent. The best known salt was the arseniate. Never saw any blue produced in the arsenic acid process for magenta. Did not know that arsenic acid with excess of aniline would produce blue.

Cross-examined by Mr. Grove: Obtained the best colour with acetate of soda and benzoic acid. That colour did not seem violet. There were no absolutely pure colours in nature. [Nothing of importance was elicited in the remainder of Dr. Miller's cross-examination; but it may be worth mentioning that in course of it a question arose as to what degree Centigrade was equal to 320° F. Several chemists in court volunteered to calculate this, and the following were some of the results called out:— 140° C., 145° C., 143° C., 160° C.]

Hugo Levinstein, examined by Mr. Aston: [In order to get the whole of the evidence into this volume, we are compelled to omit all but that part of the defendant's evidence which is most important to our readers.] Has been a maker of aniline and other colours for some years. Is not a scientific chemist; employed chemists. Had tried Girard's process at Milan, but never succeeded in getting a good colour by means of it. In his own process uses the base rosaniline, sometimes, also, hydrochlorate of rosaniline. In both cases he mixes acetic acid in the vessel. Does not add commercial aniline, but uses the waste product which distils over in making magenta red. This waste product will not make red aniline dye; does not give a trace of red. It is not the form in which aniline is sold. Aniline of commerce will make red aniline dye. Did use a small proportion of benzoic acid, but does not now. Uses acetate of soda and glacial acetic acid to form the melt. The proportion of glacial acetic acid was one-fourth the weight of the red aniline base. Heated, according to the proportion of acetate of soda, from half an hour to an hour. Gets in this way a perfect blue, which may be purified by sulphuric or hydrochloric acid. Sells it impure in England. Does not use hydrochloric acid in England. Uses sulphuric acid to precipitate the colour, and then boils with more glacial acetic acid and alcohol. One ounce of the acid to a pint of alcohol.

We omit the cross-examination by Mr. Grove, as very little of it bore on the scientific points in dispute, to which our report is confined.

Mr. Bagshawe summed up the evidence for the defendant, and was replied to by Mr. Grove. We understood the Vice-Chancellor to express an opinion in favour of the validity of Girard's patent; but he reserved his decision as to the alleged infringement.

Science in the Witness-Box.—A writer in *Blackwood's Magazine* makes the following remarks on the examination of scientific witnesses in courts of law:—"The grandest achievement of all is a poisoning case—something that is to be two-thirds emotional and one-third scientific—where the interest vacillates between the most powerful passions and the pangs of arsenic; and the listener is alternately carried from the domestic hearth to the laboratory and back again. Now, when one is aware that the 'learned Serjeant' knows as much about chemistry as a washerwoman does of the 'wave theory,' the display of impromptu learning he makes is positively astounding. Armed with an hour's reading of Beck and Orfila, the great man comes down to court to puzzle, bewilder, and very often to confute men of real ability and acquirement; to hold them up to the world as hopelessly ignorant of all that they had devoted their lives to master; and in some cases to exhibit the very science they profess as a mass of crude disjointed facts, from which no inference could be drawn, or a safe conclusion derived.

. . . A pitiable spectacle is that poor man of science, pilloried up in the witness-box, and pelted by the flippant ignorance of his examiner! What a contrast between the diffident caution of true knowledge, and the bold assurance, the chuckling confidence, the vainglorious self-satisfaction, and mock triumphant delight of his questioner! Mark the practised leer, the Old Bailey grin with which he comments on something that science still regards as uncertain or obscure, and hear him declare to the jury that, in the present state of medical knowledge, there is not a man in court might not be indicted for having handed the salt or the mustard to his neighbour!"

Detection of the Adulteration of Arrowroot with Potato or Corn Starch.—According to J. F. Albers (*Arch. de Pharm.*), this is effected with certainty by means of their behaviour towards hydrochloric acid. When one part arrowroot is shaken with three parts of a mixture of two parts hydrochloric acid of 1.12 sp. gr. and one part of distilled water, at ordinary temperatures, for about three minutes, no reaction is observable. But should corn starch be subjected to this treatment, it becomes changed into a gelatinous, translucent, and finally into a semi-fluid mass. Potato starch behaves in the same way, with the production of an easily recognised and characteristic smell. If a mixture of arrowroot with one or more of these substances is to be dealt with, the arrowroot is to be separated by treating the whole for two to three hours with the hydrochloric acid, by which the arrowroot becomes soluble, and may be filtered from the remaining softish mass, which when washed, dried in the air, and weighed, shows by the loss in weight the amount of arrowroot present.

ANSWERS TO CORRESPONDENTS.

. In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

. All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements and Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commences on January 6, 1865, and will be complete in 26 numbers.

M. Leduc.—Mr. Solomons, Red Lion Square, London, will furnish it. *G., Belfast.*—It was read before the Royal Dublin Society, and printed by M'Gill, of the Dublin University Press, from whom you will probably be able to procure it. The writer is thanked for his suggestion. *Magenta.*—The decision has not yet been given. *Received.*—C. R.; R. T. Clarke.

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